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MYCOTAXON

AN INTERNATIONAL JOURNAL FOR RESEARCH ON
TAXONOMY & NOMENCLATURE OF FUNGI, INCLUDING LICHENS

Volume LXXVIII April-June 2001

CONTENTS

Myxomycetes of the Great Smoky Mountains National Park
Steven L. Stephenson, Martin Schnittler, David W. Mitchell, & Yuri K. Novozhilov 1
Phytophthora oryzo-bladis, a new species name for *P. fragariae* var. *oryzo-bladis*
H. H. Ho 17
New species or interesting records of foliicolous lichens. VI. *Sporopodium aeruginascens* (Lecanorales), with notes on the chemistry of *Sporopodium*
Robert Lücking & H. Thorsten Lumbsch 23
Notes on Hyphomycetes. LXXXI. *Acrodictyella obovata*, a new lignicolous, dematiaceous genus and species collected in Alabama
William A. Baker, E. Christopher Partridge, & Gareth Morgan-Jones 29
Morphological variability and implications for definition of taxa in the *Descolea-Setchelliogaster-Descomyces* complex **M. Lago, N. L. Bougher, & M. L. Castro** 37
New species of Coelomycetes from Argentina **María Virginia Bianchinotti** 59
Notes on the bambusicolous species of the genus *Hypocrella* from southwestern China
Pei-Gui Liu, Xiang-Hua Wang, Zu-Qiang Li, Zhu-Liang Yang, & Da-Cheng Zhang 67
Foliicolous and caulicolous fungi associated with Proteaceae cultivated in California **Joanne E. Taylor, Pedro W. Crous, & Lizeth Swart** 75
Tylopilus pakaraimensis sp. nov., a new bolete in *Tylopilus* section *Potamogetones* from Guyana **Terry W. Henkel** 105
Entomogenous *Cordyceps* and related genera from Mexico with discussion on their hosts and new records **Gastón Guzmán, Miguel Angel Morón & Florencia Ramírez-Guillén** 115
Notes on Hyphomycetes. LXXXII. A further contribution toward a monograph of the genus *Haplotrichum* **E. Christopher Partridge, William A. Baker & Gareth Morgan-Jones** 127
Pezicula magnispora, a new species on an herbaceous plant
Zhihong Zhong, Zheng Wang & Donald H. Pfister 161
Eleutheromyces longispora sp. nov., with a *Hyphozyma* synanamorph isolated from decaying basidioma of *Trametes versicolor* **Nitaro Maekawa & Akihiko Tsuneda** 167
Notes on Hyphomycetes. LXXXIII. *Castanedaea*, a new genus in which to accommodate *Alysidium minus* **E. Christopher Partridge, William A. Baker & Gareth Morgan-Jones** 175
A new species of *Pholiota* from India **K. Agretious Thomas & P. Manimohan** 181
Dictyosporium triramosum, a new Hyphomycetes from Argentina
A. M. Arambarri, M. N. Cabello, & M. C. Cazau 185

ISSN 0093-4666 MYXNAE 78:1-540 (2001)

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[Contents continued from front cover]

Chorologic database of European *Rhizopogon* species **María P. Martín** 191
Studies in Neotropical polypores 12. New and noteworthy polypores from Mexico **Leif Ryvarden & Gaston Guzmán** 245
Molecular data confirm *Setchelliogaster tenuipes* and *S. reophylla* as Cortinariales **María P. Martín & Gabriel Moreno** 257
Taxonomical studies in Ustilaginales. XXI **Kálmán Vánky** 265
A reassessment of the *Cercospora* species described by C. Chupp: specimens deposited at BPI, Maryland, U. S. A. **Pedro W. Crous & Uwe Braun** 327
P*uccinia austroyunnanica* sp. nov. on Gouania **Jian-Yun Zhuang & Shu-Xia Wei** 345
Some noteworthy tropical species of *Uromyces* from Hainan Island **Jian-Yun Zhuang & Shu-Xia Wei** 349
Stegolerium kukenani gen. et sp. nov. an endophytic taxol producing fungus from the Roraima and Kukenan tepuis of Venezuela **Gary Strobel, W. M. Hess, Gary Baird, Eugene Ford, J. Y. Li, & Rajinder S. Sidhu** 353
The sorediate species of the genus *Menegazzia* (Parmeliaceae, lichenized Ascomycotina) in southermost South America **Jarle W. Bjerke & Arve Elvebakk** 363
Studies in neotropical polypores 9. A critical checklist of poroid fungi from Venezuela **Leif Ryvarden & Teresa Iturriaga** 393
Identification of the photobionts in *Trapeliopsis* and *Pertusaria* using SSU ribosomal DNA sequences obtained from PCR amplification with a non-green-algal primer **Imke Schmitt & H. Thorsten Lumbsch** 407
Aspergillus from Brazilian mosquitoes - I. Genera *Aedes* and *Culex* from Rio de Janiero State **A. M. L. Moraes, M. Corrado, V. L. Holanda, G. L. Costa, M. Ziccardi, R. de Lourenço-de-Oliveira, & P. C. Oliveira** 413
Variability of *Hyphoderma setigerum* (Corticiaceae s. l., Basidiomycetes) in Belarus and northwest Russia **Eugene O. Yurchenko & Iva V. Zmitrovich** 423
Didymosphaerella yuccae sp. nov. **Annette W. Ramaley** 435
Notes on three white *Amanitae* of section *Phalloideae* (Amanitaceae) from China **Zhu-Liang Yang & Tai-Hui Li** 439
Foliar and stem fungal pathogens of Proteaceae in Hawaii **Joanne E. Taylor, Pedro W. Crous, & Mary E. Palm** 449
A list of type specimens of microfungi described by P. Hennings held at the herbarium of Instituto de Botânica (SP) **Luís Fernando Pascholati Gusmão & Iuri Goulart Baseia** 491
New combinations of *Cladina* epithets in *Cladonia* (Ascomycotina: Cladoniaceae) **Teuvo Ahti & Paula T. DePriest** 499
Online resources for fungal taxonomy and nomenclature: nomenclatural resources **Kathie T. Hodge** 503
Book reviews and notices **David L. Hawksworth** 505
Nomenclatural novelties proposed in volume 78 515
Author index 517
Errata 520
Index to fungous and lichen taxa 521
Reviewers 538
Publication date for volume 77 538
Guidelines for reviewers 539

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VOLUME LXXVIII, 2001

COMPLETE IN ONE VOLUME
CONSISTING OF iv + 540 PAGES INCLUDING FIGURES

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MYCOTAXON, LTD., P. O. BOX 264
ITHACA, NY 14851-0264, USA

www.mycotaxon.com

Printed in the United States of America

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TABLE OF CONTENTS, VOLUME SEVENTY-EIGHT

April-June 2001

Myxomycetes of the Great Smoky Mountains National Park
Steven L. Stephenson, Martin Schnittler, David W. Mitchell, & Yuri K. Novozhilov 1
Phytophthora oryzo-bladis, a new species name for *P. fragariae* var. *oryzo-bladis*
H. H. Ho 17
New species or interesting records of foliicolous lichens. VI. *Sporopodium aeruginascens* (Lecanorales), with notes on the chemistry of *Sporopodium*
Robert Lücking & H. Thorsten Lumbsch 23
Notes on Hyphomycetes. LXXXI. *Acrodictyella obovata,* a new lignicolous, dematiaceous genus and species collected in Alabama
William A. Baker, E. Christopher Partridge, & Gareth Morgan-Jones 29
Morphological variability and implications for definition of taxa in the *Descolea-Setchelliogaster-Descomyces* complex
M. Lago, N. L. Bougher, & M. L. Castro 37
New species of Coelomycetes from Argentina **María Virginia Bianchinotti** 59
Notes on the bambusicolous species of the genus *Hypocrella* from southwestern China **Pei-Gui Liu, Xiang-Hua Wang, Zu-Qiang Li, Zhu-Liang Yang, & Da-Cheng Zhang** 67
Foliicolous and caulicolous fungi associated with Proteaceae cultivated in California **Joanne E. Taylor, Pedro W. Crous, & Lizeth Swart** 75
Tylopilus pakaraimensis sp. nov., a new bolete in *Tylopilus* section *Potamogetones* from Guyana **Terry W. Henkel** 105
Entomogenous *Cordyceps* and related genera from Mexico with discussion on their hosts and new records **Gastón Guzmán, Miguel Angel Morón & Florencia Ramírez-Guillén** 115
Notes on Hyphomycetes. LXXXII. A further contribution toward a monograph of the genus *Haplotrichum* **E. Christopher Partridge, William A. Baker & Gareth Morgan-Jones** 127
Pezicula magnispora, a new species on an herbaceous plant
Zhihong Zhong, Zheng Wang & Donald H. Pfister 161
Eleutheromyces longispora sp. nov., with a *Hyphozyma* synanamorph isolated from decaying basidioma of *Trametes versicolor*
Nitaro Maekawa & Akihiko Tsuneda 167
Notes on Hyphomycetes. LXXXIII. *Castanedaea,* a new genus in which to accommodate *Alysidium minus* **E. Christopher Partridge, William A. Baker & Gareth Morgan-Jones** 175
A new species of *Pholiota* from India **K. Agretious Thomas & P. Manimohan** 181
Dictyosporium triramosum, a new Hyphomycetes from Argentina
A. M. Arambarri, M. N. Cabello, & M. C. Cazau 185
Chorologic database of European *Rhizopogon* species **María P. Martín** 191
Studies in Neotropical polypores 12. New and noteworthy polypores from Mexico
Leif Ryvarden & Gaston Guzmán 245

Molecular data confirm *Setchelliogaster tenuipes* and *S. reophylla* as Cortinariales
María P. Martín & Gabriel Moreno 257
Taxonomical studies in Ustilaginales. XXI **Kálmán Vánky** 265
A reassessment of the *Cercospora* species described by C. Chupp: specimens deposited at BPI, Maryland, U. S. A. **Pedro W. Crous & Uwe Braun** 327
Puccinia austroyunnanica sp. nov. on Gouania
Jian-Yun Zhuang & Shu-Xia Wei 345
Some noteworthy tropical species of *Uromyces* from Hainan Island
Jian-Yun Zhuang & Shu-Xia Wei 349
Stegolerium kukenani gen. et sp. nov. an endophytic taxol producing fungus from the Roraima and Kukenan tepuis of Venezuela
Gary Strobel, W. M. Hess, Gary Baird, Eugene Ford, J. Y. Li, & Rajinder S. Sidhu 353
The sorediate species of the genus *Menegazzia* (Parmeliaceae, lichenized Ascomycotina) in southermost South America
Jarle W. Bjerke & Arve Elvebakk 363
Studies in neotropical polypores 9. A critical checklist of poroid fungi from Venezuela **Leif Ryvarden & Teresa Iturriaga** 393
Identification of the photobionts in *Trapeliopsis* and *Pertusaria* using SSU ribosomal DNA sequences obtained from PCR amplification with a non-green-algal primer **Imke Schmitt & H. Thorsten Lumbsch** 407
Aspergillus from Brazilian mosquitoes - I. Genera *Aedes* and *Culex* from Rio de Janiero State **A. M. L. Moraes, M. Corrado, V. L. Holanda, G. L. Costa, M. Ziccardi, R. de Lourenço-de-Oliveira, & P. C. Oliveira** 413
Variability of *Hyphoderma setigerum* (Corticiaceae s. l., Basidiomycetes) in Belarus and northwest Russia **Eugene O. Yurchenko & Iva V. Zmitrovich** 423
Didymosphaerella yuccae sp. nov. **Annette W. Ramaley** 435
Notes on three white *Amanitae* of section *Phalloideae* (Amanitaceae) from China
Zhu-Liang Yang & Tai-Hui Li 439
Foliar and stem fungal pathogens of Proteaceae in Hawaii
Joanne E. Taylor, Pedro W. Crous, & Mary E. Palm 449
A list of type specimens of microfungi described by P. Hennings held at the herbarium of Instituto de Botânica (SP)
Luís Fernando Pascholati Gusmão & Iuri Goulart Baseia 491
New combinations of *Cladina* epithets in *Cladonia* (Ascomycotina: Cladoniaceae)
Teuvo Ahti & Paula T. DePriest 499
Online resources for fungal taxonomy and nomenclature: nomenclatural resources
Kathie T. Hodge 503
Book reviews and notices **David L. Hawksworth** 505
Nomenclatural novelties proposed in volume 78 515
Author index 517
Errata 520
Index to fungous and lichen taxa 521
Reviewers 538
Publication date for volume 77 538
Guidelines for reviewers 539

MYCOTAXON
Volume LXXVIII, pp. 1-15 April-June 2001

MYXOMYCETES OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK

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Abstract: One hundred and sixty-eight taxa of myxomycetes are listed for the Great Smoky Mountains National Park. This total includes 92 species reported in the literature and/or represented by material deposited in the National Fungus Collections (BPI) and 75 species and one variety not previously known from the Park but obtained as field and/or moist chamber culture collections during the period of 1982 to 1999. Four of the latter (*Lamproderma granulosum*, *Licea microscopica*, *L. rufocuprea* and *L. sambucina*) are new records for North America.

Key words: biodiversity, eastern North America, slime molds, temperate forests

INTRODUCTION

There have been relatively few published reports of myxomycetes from the Great Smoky Mountains National Park. Cooley (1934) listed 58 species from eastern Tennessee, including the Great Smoky Mountains. However, he included no specific locality data. Since the specimens Cooley collected no longer exist, there is no way of knowing what species were recorded for areas within the Park. Hagelstein (1940) reported a number of species collected in the Park during the 1939 foray of the Mycological Society of America, and a complete listing of all species (a total of 64) recorded during the foray was provided by Linder (1941). Welton (1951) listed these same records and also noted 21 additional species not previously known for the Park. Several of these new records were obtained from moist chamber cultures, apparently the first time this technique had been used in studies of the myxomycete flora of the Park. Petersen (1979) included all of the species mentioned by Weldon in a checklist of all fungi recorded from the Park. The only other recent reports of which we are aware are those of Farr (1977) and Stephenson (1983), which included five species not previously known for the Park. In addition, a search of material deposited in the National Fungus

Collections (BPI) turned up a number of collections (and one new record) from the Park. The present paper represents an effort to bring together all records of myxomycetes reported from or known to occur in the Great Smoky Mountains National Park. The majority of the recent records are the result of field and moist chamber collections made during 1998 and 1999.

STUDY AREA

The Great Smoky Mountains National Park encompasses an area of 2080 km^2 in eastern Tennessee and western North Carolina between 35°28' and 35°47' N latitude. Elevations range from approximately 270 to 2000 m above sea level. Exposed rocks in the region are predominately conglomerates, slates, and quartzites, which are resistant to erosion and form soils that are acidic, with acidity generally increasing towards higher elevations and towards more xeric sites at a given elevation (Cain 1931). Annual precipitation varies from about 125-150 cm at lower elevations to more than 200 cm at the very highest elevations. Two rainy periods occur, one in winter and early spring and another in late summer. Mean monthly temperatures for January and July are 4-5° and 23-25° C at lower elevations on the north side of the Park and temperatures decrease with elevation at an average rate of 4.1° C per 1000 m (Shanks 1954).

Five forest types are dominant over most of the Park, with other types of communities (e.g., shrub balds [i.e., treeless areas], grassy balds, old fields, and rock outcrop communities) having a more limited distribution. Spruce-fir (*Picea rubens-Abies fraseri*) forests are found at elevations above 1525 m, and northern hardwood forests occur at middle elevations (1065 to 1525 m). Characteristic dominants of the latter forest type are sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), black cherry (*Prunus serotina*) and yellow birch (*Betula lutea*). At lower elevations (generally below 1065 m), pine-oak forests occupy drier ridges, and hemlock *(Tsuga canadensis*) forests often occur along riverbanks. Great laurel (*Rhododendron maximum*) is the most conspicuous element in the understory of these hemlock forests. Major tree species of pine-oak forests include Table Mountain (*Pinus pungens*), pitch (*P. rigida*), and white (*P. strobus*) pines, along with red (*Quercus rubra*), chestnut (*Q. prinus*), white (*Q. alba*), black (*Q. velutina*), and scarlet (*Q. coccinea*) oaks. Hickories (*Carya* spp.) are present in some situations. Cove hardwood forests, the most diverse of all the forest types, are found in valleys throughout the Park. Dominance in these forests is shared by a number of species. Among these are tulip-poplar (*Liriodendron tulipifera*), American basswood (*Tilia americana*), red maple (*Acer rubrum*), sweet gum (*Liquidamber styraciflua*), yellow buckeye (*Aesculus octandra*), black birch (*Betula lenta*), and dogwood (*Cornus florida*). The single most comprehensive treatment of the forest vegetation of the Park is provided by Whittaker (1956).

The Great Smoky Mountains National Park contains the largest remaining areas of old-growth forests in the eastern United States, and the number of tree species known to occur in the Park exceeds that of any other region of temperate North America. Hagelstein (1940), after collecting in the Park in 1939, suggested that "the region, with its divers typographical features, timber belts of many kinds, and heavy annual rainfall, is ideal territory for the Mycetoza, perhaps the best in the eastern United States."

ANNOTATED SPECIES LIST

Myxomycetes are arranged alphabetically by genus and then species within each of the six orders as recognized by Martin et al. (1983). Except where noted, collections reported herein are those of Steven L. Stephenson (SLS), Martin Schnittler (SC), and David W. Mitchell (DWM). These are deposited in the herbarium of Fairmont State College (FWVA), the National Fungus Collections (BPI), and the personal herbaria of David W. Mitchell and Martin Schnittler. The latter is stored at the Herbarium Haussknecht, Jena (JE). For each species represented among our own collections, an estimate of abundance is given, as indicated by the following scale: A - abundant, C - common, O - occasionally found, and R - rare. This estimate, which is based upon relative numbers of collections recorded and the experience of the authors, is not provided for those species reported previously in the literature but never collected by us. In these instances, abundance is indicated with a question mark [?]. It should be noted that a limited number of collections for a species recorded only from moist chamber cultures may not necessary indicate an actual low level of abundance, since certain substrates (e.g., bark samples from some tree species) were underrepresented in our studies. The symbol "MC" indicates species obtained from moist chamber cultures. For collections of apparently rare species, detailed data on substratum, locality, and date of collection are given, and at least one collection is cited. Bark mentioned as a substratum for moist chamber cultures refers always to the outer, non-living bark of living trees, usually collected at breast height. Nomenclature used for vascular plants follows Radford et al. (1968).

CERATIOMYXALES

Ceratiomyxa fruticulosa (O.F. Müll.) T. Macbr. [A] Reported by Linder (1941) and Weldon (1951).

Ceratiomyxa fruticulosa var. *porioides* (Alb. & Schwein.) G. Lister [R] On dead wood, spruce-fir forest along road to Clingmans Dome, 17 July 1999, SLS 11585.

ECHINOSTELIALES

Barbeyella minutissima Meyl. [R] On a decorticated *Picea rubens* log covered with leafy liverworts, spruce-fir forest along road to Clingmans Dome, 12 May 1983, SLS 1557 (Stephenson 1983).

Clastoderma debaryanum A. Blytt [O] MC, occurring repeatedly on bark of deciduous trees and shrubs (e.g., *Tilia americana* and *Rhododendron maximum*), Elkmont Campground. Also reported from field collections (Linder 1941, Weldon 1951, Stephenson 1983).

Clastoderma pachypus Nann.-Bremek. [R] MC, bark from *Prunus serotina*, mixed hardwood forest 1.5 km west of the Sugarland Visitor Center, Aug. 1999, DWM 5928.

Echinostelium apitectum K.D. Whitney [O] MC, on bark of *Tsuga canadensis* and various deciduous trees, Elkmont Campground and Newfound Gap.

Echinostelium arboreum H.W. Keller & T.E. Brooks [R] MC, on bark from *Acer rubrum*, Elkmont Campground, 17 Sept. 1998, SC 12353.

Echinostelium bisporum (L.S. Olive & Stoian.) K.D. Whitney & L.S. Olive apud Whitney, Benett & Olive [R] Appeared in a culture of aerial litter collected for isolation of protostelids, yellow poplar-sycamore (*Platanus occidentalis*) forest, Twin Springs ATBI plot, 1999 field season.

Echinostelium minutum de Bary [A] MC, developed regularly in moist chamber culture on bark from deciduous and coniferous trees (Stephenson 1983).

LICEALES

Cribraria argillacea (Pers.) Pers. [O] On decaying wood, spruce-fir forest along road to Clingmans Dome, 21 July 1988, SLS 5034.

Cribraria atrofusca G.W. Martin & Lovejoy [?] Reported by Farr (1979).

Cribraria cancellata (Batsch) Nann.-Bremek. [C] Reported, as *Dictydium cancellatum*, by Linder (1941) and Weldon (1951).

Cribraria confusa Nann.-Bremek. & Y. Yamam. [A] MC, bark from *Tsuga canadensis* and various deciduous trees, predominantly at lower elevations.

Cribraria elegans Berk. & M.A. Curtis ex Berk. [?] Reported by Linder (1941).

Cribraria ferruginosa Meyl. [R] On decaying wood, spruce-fir forest along road to Clingmans Dome, 14 Sept. 1985, SLS 3673.

Cribraria intricata Schrad. [?] Reported by Linder (1941) and Weldon (1951).

Cribraria languescens Rex. [?] Reported by Weldon (1951).

Cribraria macrocarpa Schrad. [?] Reported by Weldon (1951).

Cribraria microcarpa (Schrad.) Pers. [O] MC, bark of *Oxydendron arboreum* (sourwood), Cades Cove, Sept. 1998, SC 12638. Also reported by Weldon (1951).

Cribraria purpurea Schrad. [R] On decaying wood, spruce-fir forest along road to Clingmans Dome, 14 Sept. 1985, SLS 3651. Also reported by Weldon (1951).

Cribraria rufa (Roth) Rostaf. [R] On decaying wood, spruce-fir forest along road to Clingmans Dome, 14 Sept. 1985, SLS 3664. Also reported by Weldon (1951).

Cribraria splendens (Schrad.) Pers. [?] Reported by Linder (1941) and Weldon (1951).

Cribraria tenella Schrad. [?] Reported by Linder (1941) and Weldon (1951).

Cribraria violacea Rex [A] MC, bark from various deciduous trees, all at lower elevations.

Dictydiaethalium plumbeum (Schum.) Rostaf. [R] Collected from the bark of a living *Juniperus virginiana* (red cedar) at Cades Cove, 18. Sept. 1998, SLS 10324. Also reported by Linder (1941) and Weldon (1951).

Enteridium lycoperdon (Bull.) M.L. Farr. [R] On the upper side of moderately decayed log, cove hardwood forest along Ramsay Cascade Trail, 19 Sept. 1999, SC 15667.

Licea cf. *belmontiana* Nann.-Bremek. [R] MC, bark of *Juniperus virginiana*, Cades Cove, Aug. 1999, DWM 5906.

Licea biforis Morgan [R] MC, bark of *Acer rubrum*, Elkmont Campground, 17 Sept. 1998, SC 12622.

Licea castanea G. Lister [R] MC, bark of *Cornus florida*, Cades Cove, Aug. 1999, DWM 5842.

Licea denudescens H.W. Keller & T.E. Brooks [R] MC, bark of *Juniperus virginiana*, Cades Cove, Aug. 1999, DWM 5894.

Licea kleistobolus G.W. Martin [R] MC, bark of *Picea rubens*, spruce-fir forest along road to Clingmans Dome, May 1983, SLS 1896.

Licea microscopica D.W. Mitch. [R] MC, bark of *Liriodendron tulipifera*, Cades Cove, Aug. 1999, DWM 5868. This is the first known collection of this species outside the British Isles.

Licea minima Fr. [O] Decaying *Picea rubens* log, spruce-fir forest along road to Clingmans Dome, 10 May 1982, SLS 539 (Stephenson 1983).

Licea operculata (Wingate) G.W. Martin [A] MC, common on bark of deciduous trees at lower elevations. Also reported by Weldon (1951).

Licea parasitica (Zukal) G.W. Martin [C] MC, recorded several times from lower elevations. Also found on bark of *Betula lutea*, spruce-fir forest along road to Clingmans Dome, May 1984, SLS 3064.

Licea pedicellata (H.C. Gilbert) H.C. Gilbert [R] MC, bark of *Juniperus virginiana*, Cades Cove, Aug. 1999, DWM 5896.

Licea perexigua T.E. Brooks & H.W. Keller apud H.W. Keller & T.E. Brooks [R] MC, bark of *Quercus stellata* (post oak), Cades Cove, Aug. 1999, DWM 5905.

Licea pusilla Schrad. [R] On wood and lichens, spruce-fir forest along road to Clingmans Dome, 21 July 1988, SLS 4999.

Licea pseudoconica T.E. Brooks & H.W. Keller apud H.W. Keller & T.E. Brooks [R], MC, bark of *Nyssa sylvatica* (black gum), Cades Cove, Aug. 1999, DWM 5892.

Licea rufocuprea Nann.-Bremek. & Y. Yamam. [R] MC, bark of *Prunus serotina*, Cades Cove, Aug. 1999, DWM 5936.

Licea sambucina D.W. Mitch. [R] MC, bark of *Sambucus pubens*, Clingmans Dome, Aug. 1999, DWM 5812. This is the first known collection of this species in North America.

Licea scyphoides T.E. Brooks & H.W. Keller [R] MC, bark of *Aesculus octandra*, Cades Cove, Aug. 1999, DWM 5832.

Lycogala epidendrum (L.) Fr. [A] Also reported by Linder (1941) and Weldon (1951).

Lycogala exiguum Morgan. [?] Reported by Linder (1941).

Tubifera dimorphotheca Nann.-Bremek. & Loerak. [R] Decaying wood of a deciduous tree, Cades Cove, 4 Aug. 1999, Roland McHugh 674.

Tubifera ferruginosa (Batsch) J.F. Gmel. [C] Reported by Weldon (1951) and Stephenson (1983).

PHYSARALES

Badhamia nitens Berk. [R] MC, bark of *Acer rubrum*, Cades Cove, Aug. 1999, DWM 5845.

Badhamia papaveracea Berk. & Ravenel [R] Decaying bark, mixed hardwood forest, Cades Cove, 17 July 1999, SLS 11660.

Badhamia rugulosa T.E. Brooks & H.W. Keller [R] MC, bark of *Cornus florida*, Cades Cove, Aug. 1999, DWM 5869.

Badhamiopsis ainoae (Yamashiro) T.E. Brooks & H.W. Keller [O] MC, bark of *Aesculus octandra*, cove hardwood forest along road to Newfound Gap, Aug. 1999, DWM 5836. Also observed in the field on bark of *Juniperus virginiana*, Cades Cove, July 1999, SLS 11685.

Craterium minutum (Leers) Fr. [O] MC, coniferous litter, spruce-fir forest along road to Clingmans Dome, July 1988, SLS 5085.

Craterium obovatum Peck [R] Moss-covered decaying wood, spruce-fir forest along road to Clingmans Dome, 14 Sept. 1985, SLS 3621. Also reported, as *Badhamia curtisii*, by Weldon (1951).

Diachea bulbillosa (Berk. & Broome) Lister ex Penzig [?] Reported by Hagelstein (1940) and Linder (1941).

Diachea leucopodia (Bull.) Rostaf. [O] Fairly common on leafy litter, especially in shrub balds at higher elevations. Also reported by Linder (1941).

Diachea splendens Peck [R] On leaf litter from deciduous trees, Twin Springs, 20 Sept. 1999, SC 15683.

Diachea subsessilis Peck [R] MC, forest floor litter, Chasteen Creek Trail, summer 1999, SLS 13243 .

Diachea cf. *verrucospora* Nann.-Bremek. & Y. Yamam. [R] On moss and leafy litteron the forest floor, mixed hardwood forest, Cades Cove, 18 July 1999, SLS 11675. From all described species of *Diachea*, this collection comes closest to *D. verrucospora*, known only from Japan. It differs from the latter by having a shorter, stout and calcareous stalk, a more robust and rigid capillitium, and slightly denser verruculose spores.

Diderma corrugatum T.E. Brooks & H.W. Keller apud T.E. Brooks, H.W. Keller & Chassain [O] Collected in the field on bark of *Cornus florida*, Cades Cove, Aug. 1999, DWM 5845.

Diderma deplanatum Fr. [O] MC, bark of *Vitis* sp. (grape) and *Quercus rubra*, Huskey Gap Trail, Twin Creeks.

Diderma effusum (Schwein.) Morgan [O] Reported by Linder (1941) and Weldon (1951).

Diderma hemisphaericum (Bull.) Hornem. [?] Reported by Linder (1941) and Weldon (1951).

Diderma ochraceum Hoffm. [R] Moss-covered decaying wood, spruce-fir forest along road to Clingmans Dome, 14 Sept. 1985, SLS 3641.

Diderma roanense (Rex) T. Macbr. [R] On the bark of a decaying log of *Picea rubens*, spruce-fir forest along road to Clingmans Dome, 14 Sept. 1985, SLS 3661.

Diderma rugosum (Rex) T. Macbr. [R] Reported by Linder (1941) and Weldon (1951).

Diderma testaceum (Schrad.) Pers. [C] Observed several times on leafy litter in shrub balds. Also reported by Linder (1941) and Weldon (1951).

Didymium bahiense Gottsberger [R] On a bale of straw, along road to Cosby Campground, 17 July 1999, SLS 11705.

Didymium clavus (Alb. & Schwein.) Rab. [R] On leafy litter of *Rubus* sp. (blackberry), spruce-fir forest along the road to Clingmans Dome, 25 Sept. 1999, SC 15804.

Didymium crustaceum Fr. [?] Reported by Hagelstein (1940) and Linder (1941).

Didymium iridis (Ditmar) Fr. [O] MC, bark of *Juniperus virginiana*, Cades Cove, 18 Sept. 1998, SC 12318. Also reported from field collections by Weldon (1951).

Didymium melanospermum (Pers.) T. Macbr. [A] Very common on leafy litter in shrub balds at higher elevations.

Didymium minus (Lister) Morgan [?] Reported by Weldon (1951).

Didymium nigripes (Link) Fr. [O] Collected from litter of *Rubus* sp. in shrub balds. Reported by Linder (1941) and Weldon (1951).

Didymium ovoideum Nann.-Bremek. [R] On leafy liverworts near the base of a tree, along Cosby Creek near Cosby Campground, 5 Oct. 1999, SC 15835.

Didymium squamulosum (Alb. & Schwein.) Fr. [O] Reported by Linder (1941).

Elaeomyxa miyazakiensis (Emoto) Hagelst. [R] Found three times, always on bark at the base of trunks of living *Platanus occidentalis*, Cosby Campground, 4 Oct. 1999, SC 15824 (Figs. 1-4).

Fuligo leviderma H. Neubert, Nowotny & K. Baumann Myxom. 2, 1995: 211 [R] Collected from the base of a moss-covered trunk of *Platanus occidentalis*, Cosby Campground, 5 Oct. 1999, SC 15821.

Fuligo septica (L.) Wiggers [A] Reported by Linder (1941) and Weldon (1951).

Leocarpus fragilis (Dicks.) Rostaf. [O] Reported by Linder (1941) and Weldon (1951).

Lepidoderma tigrinum (Schrad.) Rostaf. [O] Fairly common on moss-covered, decorticated coniferous logs in late autumn at higher elevations (Stephenson 1983). Also reported by Weldon (1951).

Physarum bivalve Pers. [O] Leafy litter of *Solidago glomerata* (goldenrod), shrub balds with *Rubus* sp., along Forney Ridge Trail. Also reported by Linder (1941).

Physarum cinereum (Batsch) Pers. [O] Found repeatedly in the same situation as the previous species. Also reported by Linder (1941).

Physarum contextum (Pers.) Pers. [?] Reported by Linder (1941) and Weldon (1951).

Physarum compressum Alb. & Schwein. [R] On a bale of straw, along road to Cosby Campground, 17 July 1999, SLS 11704.

Physarum crateriforme Petch [C] MC, bark of various deciduous trees and *Juniperus virginiana*, always at lower elevations.

Physarum decipiens M.A. Curtis [R] MC, bark of *Quercus stellata*, Cades Cove, Aug. 1999, DWM 5875.

Physarum flavicomum Berk. [R] MC, bark of *Tsuga canadensis*, Elkmont Campground, 17 Sept. 1998, SC 12363.

Physarum flavidum (Peck) Peck [?] Reported, as *P. citrinellum*, by Hagelstein (1940) and Linder (1941).

Physarum globuliferum (Bull.) Pers. [?] Reported by Linder (1941) and Weldon (1951).

Physarum lateritium (Berk. & Ravenel) Morgan [?] Reported by Linder (1941).

Physarum leucopus Link [?] Reported by Hagelstein (1940) and Linder (1941).

Physarum listeri T. Macbr. [?] Reported by Hagelstein (1940) and Linder (1941).

Physarum melleum (Berk. & Broome) Massee [R] On bark of living *Platanus occidentalis*, at the base of the trunk, Cosby Campground, 6 Oct. 1999, SC 15816. Also reported by Linder (1941).

Physarum murinum Lister [?] On moss and decayed wood, Parsons Branch, 5 Sept. 1977, BPI #807854, M.L. Farr.

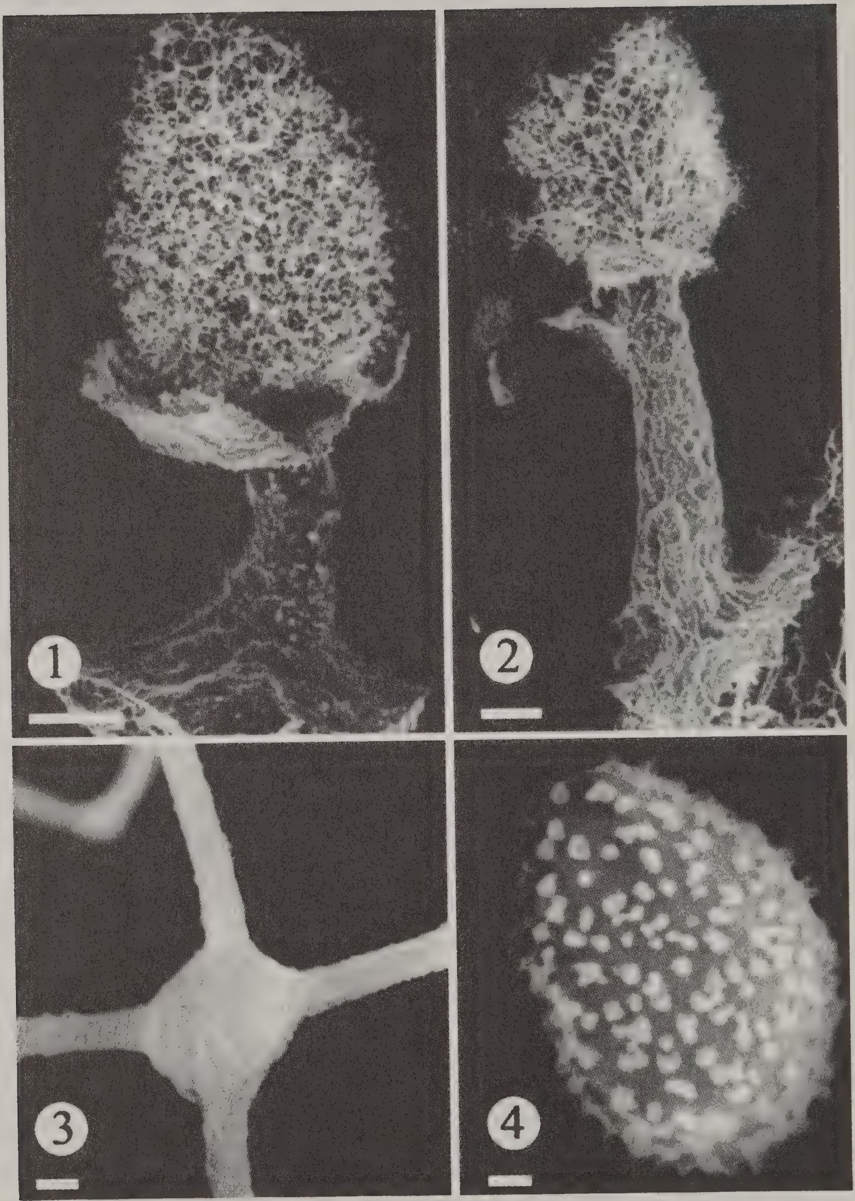
Physarum nucleatum Rex [?] Reported by Linder (1941).

Physarum nutans Pers. [C] Reported by Linder (1941) and Weldon (1951).

Physarum penetrale Rex [?] Reported by Linder (1941).

Physarum psittacinum Ditmar [?] Reported by Linder (1941).

Physarum pulcherrimum Berk. & Rav. in Berk. [R] On bark of decaying stump, mixed hardwood forest along road to Cades Cove, 18 July 1999, SLS 11695. Also reported by Linder (1941).



Figs. 1-4. SEM micrographs of *Elaeomyxa miyazakiensis* (Emoto) Hagelst. (Schnittler 15824). 1, 2 Two sporocarps showing the typical isodiametric capillitial net; bar = 100 µm. 3 Detail of a capillitial node; bar = 1 µm. 4 Spore ornamentation; bar = 1 µm. Photos by Y.K. Novozhilov.

Physarum stellatum (Massee) G.W. Martin [R] On bark of living *Platanus occidentalis*, base of trunk, Cosby Campground, 6 Oct. 1999, SC 15842. Also reported by Weldon (1951).

Physarum sulphureum Alb. & Schwein. [?] Reported by Linder (1941).

Physarum superbum Hagelst. [?] Reported by Linder (1941).

Physarum tenerum Rex [?] Reported by Linder (1941) and Weldon (1951).

Physarum viride (Bull.) Pers. [O] Relatively common at higher elevations. Also reported by Linder (1941) and Weldon (1951).

Trabrooksia applanata H.W. Keller [R] MC, bark of *Quercus alba*, Cades Cove, Aug. 1999, DWM 5887.

Willkommlangea reticulata (Alb. & Schwein.) Kuntze [R] On dead stems of *Rubus* sp., shrub bald 1.3 km SSE of Clingmans Dome, 23 Sept. 1999, SC 15764.

TRICHALES

Arcyria cinerea (Bull.) Pers. [A] MC, bark of various trees, but also commonly found in the field on decaying wood. Reported also by Linder (1941), Weldon (1951) and Stephenson (1983).

Arcyria denudata (L.) Wettst. [C] Reported by Linder (1941) and Weldon (1951).

Arcyria ferruginea Saut. [R] On decaying wood, spruce-fir forest along road to Clingmans Dome, 8 Oct. 1988, SLS 5224.

Arcyria incarnata (Pers.) Pers. [?] Reported by Linder (1941) and Weldon (1951).

Arcyria insignis Kalchbr. & Cooke [?] Reported by Weldon (1951).

Arcyria obvelata (Oeder) Onsberg [R] Decaying wood, spruce-fir forest along the road to Clingmans Dome, 21 July 1988, SLS 5020.

Arcyria pomiformis (Leers) Rostaf. [R] On decaying wood, northern hardwood forest along trail from Newfound Gap to Boulevard, 22 July 1999, SLS 11777.

Arcyria stipata (Schwein.) Lister [R] MC, deciduous litter, beech forest along road to Clingmans Dome, July 1999, SLS 13054.

Calomyxa metallica (Berk.) Nieuwl. [O] MC, bark of various deciduous trees at lower elevations. Also one field collection from a decorticated log of *Abies fraseri*, near Clingman's Dome, 20 Sept. 1999, SC 12360.

Dianema corticatum Lister [R] Decaying wood, spruce-fir forest along the road to Clingmans Dome, 14 Sept. 1985, SLS 3644.

Dianema harveyi Rex [R] MC, bark of *Juniperus virginiana*, Cades Cove, Aug. 1999, DWM 5898.

Hemitrichia calyculata (Speg.) M.L. Farr. [A] Reported, as *Hemitrichia stipitata*, by Weldon (1951).

Hemitrichia clavata (Pers.) Rostaf. [?] Reported by Linder (1941) and Weldon (1951).

Hemitrichia serpula (Scop.) Rostaf. [O] Reported by Linder (1941) and Weldon (1951).

Metatrichia floriformis (Schwein.) Nann.-Bremek. [O] Reported, as *Trichia floriformis*, by Linder (1941).

Metatrichia vesparium (Batsch) Nann.-Bremek. ex G.W. Martin & Alexop. [A] Reported by Linder (1941), Weldon (1951) and Stephenson (1983).

Oligonema flavidum (Peck) Peck [?] Reported by Linder (1941) and Weldon (1951).

Oligonema schweinitzii (Berk.) G.W. Martin [?] Reported by Weldon (1951).

Perichaena chrysosperma (Curr.) Lister [C] MC, on bark of various deciduous trees, mostly at lower elevations. Also reported by Hagelstein (1940), Linder (1941) and Weldon (1951).

Perichaena corticalis (Batsch) Rostaf. [R] MC, bark of *Tilia americana*, Twin Creek, 17 Sept. 1998, SC 12721.

Perichaena depressa Lib. [?] Reported from the Park by Weldon (1951).

Perichaena minor (G. Lister) Hagelst. var. *pardina* Minakata [O] MC, several times on the bark of deciduous trees, Twin Creek, Elkmont Campground. Also known from the bark of *Juniperus virginiana*, Cades Cove.

Perichaena vermicularis (Schwein.) Rostaf. [A] MC, bark of deciduous trees at lower elevations.

Prototrichia metallica (Berk.) Massee [?] Known from a single collection, Clingmans Dome (Hagelstein 1940).

Trichia botrytis (J.F. Gmel.) Pers. [O] Coniferous logs at higher elevations. Reported by Linder (1941), Weldon (1951) and Stephenson (1983).

Trichia contorta (Ditmar) Rostaf. [?] Reported by Weldon (1951).

Trichia decipiens (Pers.) T. Macbr. [O] On moss-covered, decorticated logs of *Abies fraseri*, Mt. Collins, spruce-fir forest, 5 Oct. 1999, SC 15807. Reported by Linder (1941) and Stephenson (1983).

Trichia erecta Rex [C] Fairly common on the inner side of loosely adhering bark of coniferous logs at higher elevations. Also reported by Hagelstein (1940) and Linder (1941).

Trichia favoginea (Batsch) Pers. [C] Occurring on strongly decayed coniferous logs, higher to middle elevations (see also Linder 1941). If the species is understood in a wider sense as suggested by Farr (1958), *T. persimilis* Karst., found to be the predominate form at lower elevations, is included here.

Trichia scabra Rostaf. [?] Reported by Weldon (1951).

Trichia subfusca Rex [O] Collected from decorticated coniferous logs, spruce-fir forests at higher elevations. Also reported by Linder (1941), Weldon (1951) and Stephenson (1983).

Trichia varia (Pers. ex J.F. Gmel.) Pers. [C] Reported by Linder (1941).

STEMONITALES

Collaria arcyrionema (Rostaf.) Nann.-Bremek. ex Ing [O] Reported, as *Lamproderma arcyrionema*, by Linder (1941), Weldon (1951).

Collaria lurida (Lister) Nann.-Bremek. [O] MC, deciduous litter, northern hardwood forest along Thomas Divide Trail, July 1999, SLS 12482.

Colloderma oculatum (Lippert) G. Lister [C] Occurring in two distinct, quite different microhabitats: in MC on mossy bark of deciduous trees, at lower to middle elevations, and observed in the field on decorticated logs of *Picea rubens*, spruce-fir forest along road to Clingmans Dome, 14 Sept. 1985, SLS 3682.

Comatricha aequalis Peck [R] Decaying wood, spruce-fir forest along road to Clingmans Dome, 12 May 1983, SLS 1574.

Comatricha ellae Härk. [R] MC, bark of *Fraxinus americana*, northern hardwood forest, Newfound Gap, Aug. 1999, DWM 5854.

Comatricha laxa Rostaf. [R] MC, litter of coniferous trees, spruce-fir forest along road to Clingmans Dome, July 1988, SLS 5075.

Comatricha nigra (Pers. ex J.F. Gmel.) Schroet. [O] Reported by Weldon (1951).

Comatricha pulchella (Bab. & Berk.) Rostaf. [?] Reported by Linder (1941) and Weldon (1951).

Comatricha reticulospora Ing & Holland [R] MC, coniferous litter, spruce-fir forest along road to Clingmans Dome, May 1983, SLS 624.

Comatricha suksdorfii Ellis & Everh. [?] Reported by Weldon (1951).

Comatricha tenerrima (M.A. Curtis) G. Lister [R] MC, leaves and stems of dead *Rubus* sp., shrub bald near Clingmans Dome, 25 Sept. 1999, SC 15798.

Diacheopsis insessa (G. Lister) Ing [R] Moss-covered decaying wood, spruce-fir forest along road to Clingmans Dome, 16 Sept. 1983, SLS 2233.

Enerthenema papillatum (Pers.) Rostaf. [O] Reported also by Linder (1941), Weldon (1951) and Stephenson (1983).

Lamproderma columbinum (Pers.) Rostaf. [O] Mostly found at higher elevations. Also reported by Linder (1941) and Weldon (1951).

Lamproderma granulosum H. Neubert, Nowotny & Schnittler, Beitr. Kenntn. Pilze Mitteleurop. 6: 49, 1990 [R] One well-developed, large colony along small channels of trickling water on rocks with a sparse cover of the liverwort *Mylia taylori*, boulderfield on a steep, north-facing slope below the Applachian Trail near Clingmans Dome, 5 Oct. 1999, SC 15802. Comparison with the type material confirmed this to be the first record for the western hemisphere.

Lamproderma scintillans (Berk. & Broome) Morgan [O] Leafy litter, shrub balds near Clingmans Dome.

Macbrideola cornea (G. Lister & Cran) Alexop. [C] MC, bark of various deciduous trees, lower to middle elevations.

Macbrideola decapillata H.C. Gilbert [R] MC, bark of *Fraxinus americana*, cove hardwood forest along road to Newfound Gap, Aug. 1999, DWM 5837.

Macbrideola synsporos (Alexop.) Alexop. [R] MC, bark of *Nyssa sylvatica*, Cades Cove, Aug. 1999, DWM 5880.

Paradiacheopsis solitaria (Nann.-Bremek.) Nann.-Bremek. [O] MC, recorded several times from the bark of deciduous and coniferous trees, lower to middle elevations.

Stemonitis axifera (Bull.) T. Macbr. [C] Reported by Linder (1941) and Weldon (1951).

Stemonitis flavogenita Jahn [?] Reported by Weldon (1951).

Stemonitis fusca Roth [O] Reported by Linder (1941) and Weldon (1951).

Stemonitis nigrescens Rex [R] Reported by Stephenson (1983).

Stemonitis pallida Wingate [?] Reported by Linder (1941).

Stemonitis smithii T. Macbr. [R] Reported by Weldon (1951).

Stemonitis splendens Rostaf. [O] On decaying deciduous wood at lower elevations. Reported by Linder (1941) and Weldon (1951).

Stemonitis virginiensis Rex [R] Reported by Weldon (1951).

Stemonitopsis hyperopta (Meylan) Nann.-Bremek. [R] On decaying wood, spruce-fir forest along road to Clingmans Dome, 21 July 1988, SLS 5022.

Stemonitopsis typhina (Wiggers) Nann.-Bremek. [C] Reported, as *Comatricha typhoides*, by Linder (1941) and Weldon 1951).

Symphytocarpus herbaticus Ing apud Ing & Nann.-Bremek. [R] On leaf litter, mixed hardwood forest along road to Cades Cove, 18 July 1999, SLS 11646.

In addition to the myxomycetes listed above, Cooley (1934) reported 11 other species as occurring in eastern Tennessee. These additional records are *Arcyria globosa* Schwein., *Badhamia macrocarpa* (Ces.) Rostaf., *Brefeldia maxima* (Fr.) Rostaf., *Calonema aureum* Morgan, *Diderma radiatum* (L.) G. Lister, *Diderma umbilicatum* Pers., *Hemitrichia abietina* (Wigand) G. Lister, *Lamproderma arcyrioides* (Sommerf.) Rostaf., *Physarum polycephalum* Schwein., *P. pusillum* (Berk. & M.A. Curtis) G. Lister, and *P. vernum* Sommerf. in Fr. It is entirely possible that some of these records were based upon collections made within the Park, but there is no way of knowing whether or not this was indeed the case. As such, these 11 species are not yet included in the myxomycete flora of the Park, although it seems likely that they will be encountered during the course of future collecting.

RESULTS AND DISCUSSION

In summary, at least 167 species (and one variety) of myxomycetes are now known from the Great Smoky Mountains National Park. Seventy-five of these (representing 45% of the total) have been added to the myxomycete flora of the Park as a result of field and laboratory studies carried out by the four authors during the period of 1982 to 1999 (for descriptions and illustrations see Mitchell 2000). Four of the species we recorded are new records for North America. *Lamproderma granulosum* (Neubert et al. 1990) was described from rocks overgrown with leafy liverworts and provided with a source of trickling water, a microhabitat already known to support a distinctive assemblage of myxomycetes (Ing 1983). This species, hitherto known only from ravines in sandstone rocks in southeastern Germany, was discovered again during a survey of similar microhabitats in boulderfields around Clingmans Dome in October of 1999. As such, the collection reported herein is the first record for the western hemisphere. *Licea microscopica*, described originally from Wales (Mitchell 1978) and more recently reported from England and Ireland (Mitchell and McHugh 2000), was recorded for the first time outside the British Isles. *Licea rufocuprea* was described originally from Japan (Nannenga-Bremekamp & Yamamoto 1987), and the collection reported herein apparently represents the first record of the species from any other locality. It is described in detail in Mitchell (2000). *Licea sambucina*, another minute species in the genus, was recently described from Great Britain (Mitchell and McHugh 2000), where it appeared in moist chamber cultures prepared with algae-covered bark of elderberry (*Sambucus nigra*). *Sambucus pubens*, a North American species of elderberry that is fairly common in open areas at higher elevations in the Park, was found to possess the same kind of algae-covered bark. Moist chamber cultures prepared with samples of this bark also yielded *Licea sambucina*. *Fuligo leviderma*, although here formally reported for the first time for North America, is commonly confused with *Fuligo septica* var. *rufa* (Pers.) Lázaro. Critical examination of herbarium material will almost certainly produce more records of this species.

Particularly noteworthy is the rediscovery of *Elaeomyxa miyazakiensis*, a species that is apparently rare worldwide. This myxomycete is characterized by a very distinctive isodiametric capillitial net with bright yellow to orange wax droplets in the meshes (Figs. 1-4). It was found on three separate occasions on different trees of *Platanus occidentalis*. In addition to Japan, where it was described originally, the species is known from only a few localities in eastern North America. Localities of which we are aware, based on collections deposited in the National Fungus Collections (BPI), are southern Ontario (four collections [W.D. Sutton #332 and #809, E. Davis #1197 and #1478], each from a different locality), Kentucky (one collection [T.E. Brooks #3022]), and one collection (M.L. Farr #4687) for which no locality is given. Interestingly, the collection from Kentucky was found in exactly the same microhabitat (i.e., moss-covered bark of living *Platanus*) as our collections in the Park. These discoveries suggest that the microhabitat, here understood as the combination of substrate and microclimate, is of major importance in determining the distribution patterns of myxomycetes.

Another interesting record is the single collection (examined by the authors) of *Prototrichia metallica*, made by Robert Hagelstein in 1939. This species, which belongs to the distinct ecological group of nivicolous (snowbank-associated) myxomycetes, is fairly common in the high mountains of western North America. Its occurrence in the Park provides some evidence for the presence of nivicolous myxomycetes at the very highest elevations. In spite of intensive searching in apparently suitable habitats during late spring in both 1999 and 2000, no nivicolous myxomycetes were found. However, both years were characterized by mild winters with a limited snow cover, which had already melted by early March, well before the ground could warm up enough to produce favorable conditions for nivicolous myxomycetes.

Also noteworthy are the numerous records of rare myxomycetes from moist chambers prepared with the bark of *Juniperus virginiana*. This tree species has a limited distribution in the Park and is relatively common only in the old-field communities in Cades Cove. It is well known as an excellent substrate for corticolous (bark-inhabiting) myxomycetes and represents an example how the influence of humans can potentially increase the biodiversity of myxomycetes in a particular area.

With at least 68 (40%) of the 168 taxa listed herein classified as rare, and another 39 (23%) known only from older literature, our survey of the Park is still too incomplete to evaluate the myxomycete biodiversity of the Park in a worldwide context or to characterize the assemblages of myxomycetes associated with the different forest types. However, a number of basic facts are apparent from the preliminary species list presented in this paper.

First, with at least 167 species (and one variety) recorded thus far, the Park already ranks among the more diverse areas for myxomycetes on a worldwide scale. For example, only about 185 species are known from the entire state of West Virginia, where the first author has collected and studied myxomycetes for more than 20 years (Stephenson & Roody 1997; Stephenson, unpubl. data). A study of a boreal forest in northern Karelia produced 95 species (Schnittler & Novozhilov 1996). Sixty-eight species were recorded with certainty in a recent study in the western Andes of Ecuador (Schnittler, Lado & Stephenson, unpub. data).

Second, the relatively wide elevational (and resultant vegetational) gradient that exists within the park is a major contributing factor to the high species diversity. At higher elevations, several myxomycetes known from northern temperate zones were encountered. In contrast, the rich cove hardwood forests at lower elevations contain myxomycetes with a mainly tropical distribution. Prominent examples are numerous species of *Physarum* (e.g., *P. flavicomum*, *P. globuliferum*, *P. penetrale*, and *P. stellatum*).

Third, among the five major forest types present in the Park, the high-elevation spruce-fir forests have the most distinctive assemblage of myxomycetes, with species of *Trichia* (e.g., *T. erecta*, *T. botrytis*, and *T. subfusca*) as prominent examples. However, the most diverse assemblage of myxomycetes is very probably associated with cove hardwood forests.

Finally, whereas old-growth forest communities, with their rich supply of large logs, undoubtedly support a highly diverse assemblage of myxomycetes, disruptions in the forest cover that are the result of human activity have created habitats that support other ecological groups of myxomycetes, thereby enhancing the overall species diversity of the park. Examples are various litter-inhabiting myxomycetes occurring in shrub balds and the rich flora of corticolous myxomycetes on isolated trees, especially *Juniperus virginiana* in Cades Cove.

However, as already noted, the high number of apparently rare myxomycete species recorded thus far suggests that the presently known myxomycete flora of the park is still far from being complete. Because the park is a vast area of rather diverse ecology, it seems likely that future collecting will yield a significant number of additional records.

ACKNOWLEDGMENTS

Field work in the Great Smoky Mountains National Park was supported in part by a grant from Discover Life in America. We are indebted to W. Nowotny for the comparison of the American material of *Lamproderma granulosum* with the type collection.

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MYCOTAXON

Volume LXXVIII, pp. 17-21 April-June 2001

PHYTOPHTHORA ORYZO-BLADIS, A NEW NAME FOR P. FRAGARIAE VAR. ORYZO-BLADIS

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ABSTRACT

Based on a study of the isolate and the type specimen of *Phytophthora fragariae* var. *oryzo-bladis* Wang & Lu causing leaf blight of rice seedlings in China it is concluded that the fungal pathogen is distinct enough from *P. fragariae* to warrant a new species epithet and should be re-named *P. oryzo-bladis.*

Keywords: rice leaf blight; China

In 1978 a new Phytophthora disease of rice seedlings was reported in China (Wang and Lu 1978). The pathogen induced irregular brown streaks on leaf blades resulting in leaf blight and possible death of the rice seedlings, The disease was first noted in 1973 in Jiangsu Province and later in Anhui Province. It began around late April to early May when the temperature rose above 12 C, became most serious towards middle and late May (16-22 C) but declined rapidly in early June when the temperature remained consistently above 25 C. Since its initial report, other researchers also observed the disease in provinces along Yangzi River including Jiangxi (Fan 1981, Yi and Feng 1986, Xu 1989), Henan (Hu and Hu 1988) and Zhejiang (Ding 1987).

Based on the morphological features of the non-papillate, internally proliferating sporangia and sexual organs observed on diseased rice leaves, the pathogen was considered closest to *Phytophthora fragariae* Hickman but differed in having entirely antheridia instead of both amphigynous and paragynous antheridia found in *P. fragariae* (Waterhouse 1963) and in its apparent specific pathogenicity to rice. Consequently, it was designated as a new variety of the species: *P. fragariae* var. *oryzo-bladis* (Wang and Lu 1978). However, the characteristics of the single isolate of the rice seedling Phytophthora differed significantly from those of *P. fragariae*. It grew extremely fast on common agar plates like cornmeal, beanmeal and oatmeal (40-65 mm per day at 25C) producing sparse aerial mycelium and abundant chlamydospores whereas *P. fragariae* is characterized by slow growth (1.2-6.5 mmer day) , thick fluffy aerial mycelium and the absence of chlamydospores (Ho and Jong

1988). Furthermore, the isolate failed to produce sporangia or sex organs in vitro and could not reinfect rice seedlings by artiticial inoculation. In nature, the pathogen on rice seedling leaves produced abundant sporangia and sex organs but no chlamydospores (Wang and Lu 1978).

In 1983, I had the opportunity to study the isolate briefly at the Department of Plant Protection, Nanjing Agricultural University where the culture was kept. I could not induce the isolate to produce sporangia nor sexual organs but based on the growth rate, colony morphology and hyphal branching pattern as well as the numerous small "chlamydospores" formed rapidly in water, I considered it different from *P. fragariae* (Ho and Jong 1988) or any known *Phytophthora* species (Erwin and Ribeiro 1996) and most likely belonged to the genus *Pythium* found commonly in rice fields. Unfortunately, the culture was subsequently lost and the disease did not reappear due to changes in the cultural practice of rice seedlings. In 1992 when I returned to Nanjing Agricultural University I re-examined the dried type specimen instead. I found no sporangia but abundant mycelia of the fungal pathogen on the diseased leaves and clusters of brownish oogonia (Fig. 1) among the host tissues with little evidence of other fungi present. It is puzzling why only one isolate was recovered after numerous attempts of isolation with a wide variety of common media (Wang and Lu 1978) unless the pathogen was not culturable like *P. cyperi* (Ideta) Ito, *P. cyperi-bulbosi* Seethalakshmi & Ramakrishnan and *P. lepironiae* Sawada (Erwin and Ribeiro 1996) as well as *P. polygoni* Sawada (Zheng and Ho 1998). In fact, the formal Latin diagnosis of the pathogen was based solely on its morphological characteristics as seen on diseased rice seedlings with no reference to the isolate obtained (Wang and Lu 1978).

Even based on the morphological characteristics of the *Phytophthora* species on rice seedlings, there are significant differences between the pathogen and *P. fragariae* to warrant s new species epithet. The antheridial type is one of the most important taxonomic criteria in the genus *Phytophthora.* Waterhouse (1963) placed all species producing non-papillate sporangia in Groups V and VI which are distinguished by the presence of both amphigynous and paragynous antheridia in the former and only amphigynous antheridia in the latter. Since the rice seedling *Phytophthora* produced only amphigynous antheridia (Figs. 2,3) it should be placed in Group VI and not assigned to *P. fragariae* which belongs to Group V. Furthermore, I found the oogonia of the rice seedling *Phytophthora* to be globose to subglobose as reported by Wang and Lu (1978) whereas *P. fragariae* commonly produces oogonia with a conspicous tapered base (Ho and Jong 1988). As a pathogen in nature, *P. fragariae* attacks only the roots of strawberry (*Fragaria* sp.), loganberrry (*Rubus* sp.) and red raspberry (*Rubus idaeus* L.) resulting in red stele

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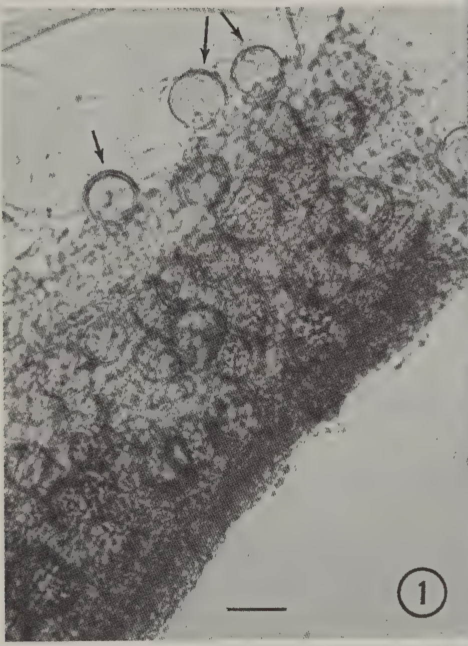
Fig. 1-3. *Phytophthora oryzo-bladis* on leaves of rice seedlings. 1. Clusters of ooogonia (arrow). Scale bar = 50μm. 2,3. Oogonia with aplerotic oospores (Os) and amphigynous antheridia (arrow). Scale bar = 10 μm.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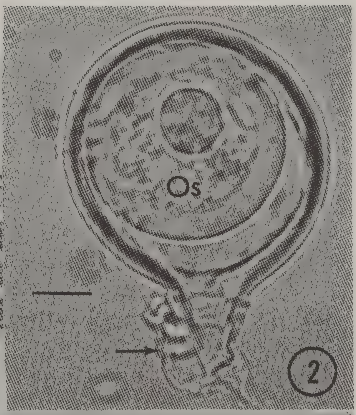
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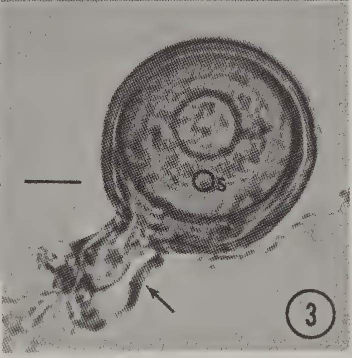
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(core) or root rot diseases (Erwin and Ribeiro 1996). All these hosts are dicotyledonous plants of the family Rosaceae. On the other hand, the rice seedling *Phytophthora* was apparently specific to rice (*Oryza sativa* L.), a monocotylenous plants in the family Poaceae (Gramineae) causing leaf blight disease. Thus the rice seedling *Phytophthora* should be treated as a new *Phytophthora* species and not a new variety of *P. fragariae*. Zheng (1995) considered the identification by Wang and Lu (1978) incorrect and did not include the trinomial in his key to *Phytophthora* species in China. It is hereby proposed that *P. fragariae* var. *oryzo-bladis* be left as doubtful and a new species be erected with a new type and new Latin diagnosis:

Phytophthora oryzo-bladis J.S.Wang & J.Y.Lu ex H.H.Ho, **sp. nov.**
= ?*Phytophthora fragariae* var. *oryzo-bladis* J.S.Wang & J.Y.Lu, Acta Microbiol. Sinica 18: 97. 1978.

Sporangiophora simplices vel sympodialiter ramosa 405-675 μm longa, sporangiis terminalibus vel lateralibus, saepe per proliferationem orientibus, obverse pyriformibus, ellipsoideis, apice obtuse rotundatis, 43.1-93.1 x 28.8-57.5μm (in medio 67 x 42.8 μm), Zoosporis formatis, reniformis, quietis 10.5-20 μm diametero.

Oogonia sphaeroidea, brunnea, 39.9-58.1 μm (in medio 46.9 μm) diametro, membranis crassis 2.2 μm, oosporiis sphaeroideis, subfuscis, 27.2 –48 μm in medio 35.5 μm diametro, membranis crassis 3 μm.

Antheridia amphigyna, subglobosa, lutea, 15-30 x 12.2-25.9 μm (in medio 21.9 x 19.2 μm), projecturis breviter parvis.

Hab. In foliis *Oryza sativa L.*, regio Hanjiang, provincia Jiangsu, Wang Jin Sheng. V 1976, 10037 (TYPUS). Cultura ignota.

Type deposited in the Plant Pathology Research Institute, Nanjing Agricultural University.

ACKNOWLEDGEMENTS

The work was supported by a grant from the National Geographical Society. Thanks are due to Dr. D.C. Erwin, Professor Emeritus of Plant Pathology, University of California, Riverside for reviewing the manuscript.

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MYCOTAXON

Volume LXXVIII, pp. 23-27 April-June 2001

NEW SPECIES OR INTERESTING RECORDS OF FOLIICOLOUS LICHENS. VI. SPOROPODIUM AERUGINASCENS (LECANORALES), WITH NOTES ON THE CHEMISTRY OF SPOROPODIUM

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Abstract: The new foliicolous lichen species *Sporopodium aeruginascens* is described from Costa Rica. It is characterized by a verrucose, turquoise-coloured thallus containing usnic and isousnic acid among other components, pruinose apothecia, and pale to bright yellow campylidia. The new species is similar and probably related to *S. flavescens*, *S. citrinum*, and *S. lucidum*, but differs in the irregularly shaped thallus verrucae, the campylidia with reduced socle and large lobe with pruinose to irregular surface, and the secondary chemistry. New data on the secondary chemistry of four additional species of *Sporopodium* are provided.

Key words: Ectolechiaceae, usnic acid, isousnic acid, vulpinic acid.

Sporopodium aeruginascens Lücking & Lumbsch sp. nova

Sporopodium citrinum thallo acido usnico et isousnico verrucis irregularibus et campylidiis latioribus differt. — Typus: Costa Rica. Heredia: La Selva Biological Station, 10° 26' N, 84° 03' W, 50-100 m, foliicolous, II. 1999, Lücking 99-105 (CR, holotypus; M, hb. Lücking, isotypi).

Description: Thallus epiphyllous, crustose, continuous but irregular in outline, up to 100 mm across and covering large areas of the leaf surface, irregularly but distinctly verrucose, pale bluish grey to turquoise-coloured, with a slight yellowish tinge; verrucae paler than the thallus, at first hemispherical, 0.05-0.1 mm diam., later irregularly papillose, with a pruinose to finely pilose surface, 0.1-0.2 mm diam. Phycobiont a species of Chlorococcaceae, cells 5-8 µm diam.

Apothecia only seen in immature stage, sessile, rounded to slightly irregular in outline, 0.2-0.3 mm diam., disc brownish but with a distinct pale pruina; margin whitish pruinose, with a very irregular surface. Mature ascospores not seen.

Campylidia numerous, 0.4-0.6 mm broad, at first seen as a whitish to bright yellow, prominent ring on the thallus surface, with reduced socle and well-developed, mussel-shaped lobe when mature, and with a whitish pruinose to bright yellow, rough to irregular surface. Wall and socle in section paraplectenchymatous, colourless, externally with a layer of free, sparsely branched, 20-50 x 2.5-3.0 µm large hyphae encrusted with yellowish brown granules which completely dissolve in KOH. Conidiogenous layer covering the basal parts of the pycnidial wall and the entire socle; conidiogenous cells bacillar, 7-10 x 1 µm, inspersed with algal cells 5-8 µm diam. Conidia drop-shaped, non-septate, 5-7 x 1.8-2.0 µm, intermingled with small algal cells 3-4 µm diam. obviously formed by division of the larger cells in the conidiogenous layer.

Chemistry: Usnic acid and thiophanic acid as major, isousnic acid, arthothelin and 4,5-dichloronorlichexanthon as minor components.

Notes: *Sporopodium aeruginascens* relates to species with yellow campylidia, including *S. flavescens* (R. Sant.) Vezda, *S. citrinum* (Zahlbr.) Elix, Lumbsch & Lücking, *S. lucidum* Aptroot & Sipman and *S. xantholeucum* (Müll. Arg.) Zahlbr. (APTROOT & SIPMAN 1993; ELIX *et al.* 1992, 1995, LÜCKING 1999).

Sporopodium lucidum has a green to lemon yellow, farinose thallus containing vulpinic acid and campylidia with a well-developed base, while the other species have pale bluish, smooth to verrucose thalli. *S. flavescens* differs by the smooth to sparsely verrucose thallus and the well-developed, whitish campylidial socle. *S. citrinum* and *S. xantholeucum* have the same irregular apothecia as *S. aeruginascens*. However, *S. xantholeucum* differs by the smooth to irregularly verrucose thallus, and the campylidia are pale yellowish and funnel-shaped. Most similar in thallus and campylidial morphology is *S. citrinum*, but its thallus verrucae are regularly hemispherical and the campylidia lobes are narrower and smooth.

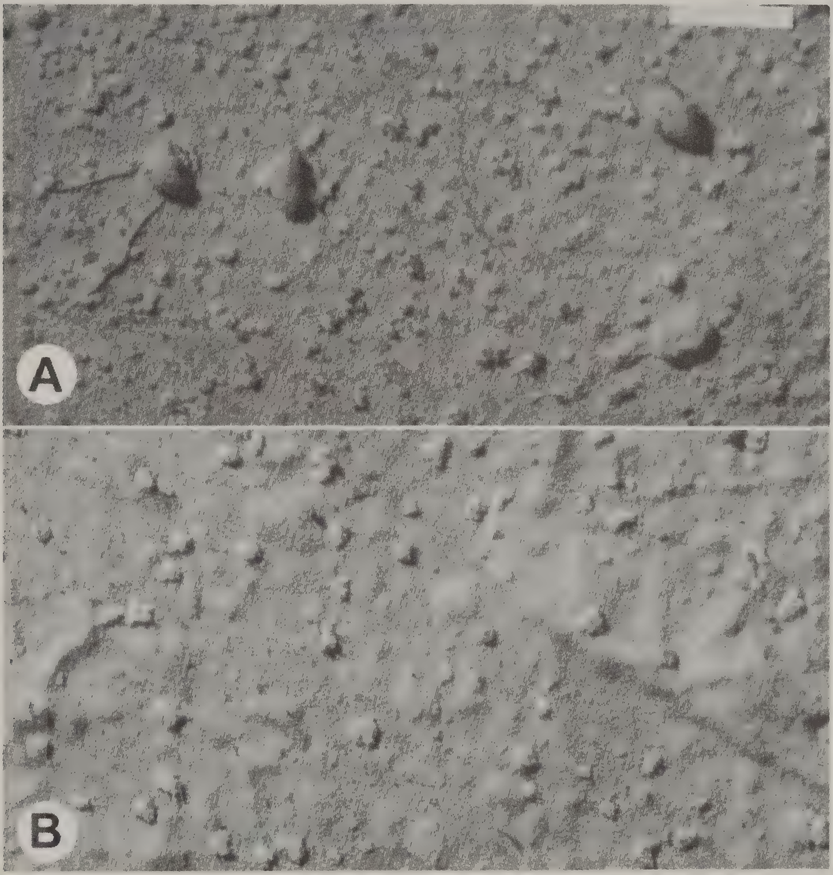

Figure 1: *Sporopodium aeruginascens* (an isotype). Thallus with four campylidia (A) and irregular verrucae (B). Scale in A = 1 mm, in B = 0.7 mm.

Table 1: Secondary substances in *Sporopodium* (after SANTESSON 1970; ELIX *et al.* 1992, 1995; and previously unpublished data). LEP = *S. leprieurii* Mont., ANT = *S. antonianum* Elix, Lumbsch & Lücking, PIL = *S. pilocarpoides* (Zahlbr.) Lücking & Kalb, AER = *S. aeruginascens* Lücking & Lumbsch, CIT = *S. citrinum* (Zahlbr.) Elix, Lumbsch & Lücking, FLA = *S. flavescens* (R. Sant.) Vezda, PHY = *S. phyllocharis* (Mont.) Massal., MAR = *S. "marginatum"*, AUR = *S. aurantiacum* (Müll. Arg.) Lücking, XAN = *S. xantholeucum* (Müll. Arg.) Zahlbr., LUC = *S. lucidum* Aptroot & Sipman. +++ = major, ++ = minor, + = trace. MNLX = methylnorlichexanthone.

	LEP	ANT	PIL	AER	CIT	FLA	PHY	MAR	AUR	XAN	LUC
Vulpinic acid											+++
Usnic acid				+++							
Isousnic acid				++							
Atranorin			+								
Argopsin	+	+									
Pannarin			+			+	+			+	++
Zeorin	+	+	+		+	+	+		++	+	
4-Chlorolichexanthone					+						
Griseoxanthone B					+						
4-Chloro-6-O-MNLX					+						
Vinetorin					+						
5-Chlornorlichexanthone					+						
2,7-Dichlorolichexanthone						+				+	
4,5-Dichlorolichexanthone					+						
5,7-Dichlorolichexanthone						+				+	
4,5-Dichloro-6-O-MNLX					+						
5,7-Dichloro-3-O-MNLX						+	+	+++		+	++
4,5-Dichloronorlichexanthone				++							
5,7-Dichloronorlichexanthone						+				+	
2,5,7-Trichlorolichexanthone						+				+	
Arthothelin	+	+		++		+			+++	+	
Isoarthothelin	+	+				+		++	++	+	
Asemone	+	+				+			+	+	
2,5,7-Trichloro-3-O-MNLX						+	+	++		+	++
Thiophanic acid	+	+		+++		+			+++	+	

The pruinose to irregular campylidia surface in *Sporopodium aeruginascens* is caused by their unique outer layer, composed of free hyphae encrusted with dark granules. In addition, while other species of the genus with bluish thalli mostly contain pannarin and zeorin (Table 1), these substances are absent from *S. aeruginascens*, which instead contains usnic and isousnic acid. The latter two substances were thus far unknown in the genus (SANTESSON 1970; ELIX *et al.* 1992, 1995).

In the course of this study we analysed four additional species of *Sporopodium* which yielded further substances previously unknown in the genus: atranorin in *S. pilocarpoides* (Zahlbr.) Lücking & Kalb comb. ined. (LÜCKING & KALB, in press), and vulpinic acid in *S. lucidum* (Table 1). The recently segregated *S. aurantiacum*, with yellow to orange thallus (LÜCKING 1999), differs from the morphologically similar *S. phyllocharis*. Also, the populations with non-pruinose apothecia and slightly prominent, orange margin (*S.* "*marginatum*" ined.), thus far referred to as *S.* aff. *phyllocharis* (LÜCKING 1999), have a slightly different chemistry and might represent a distinct species. Further studies are necessary to confirm these differences and their correlation with other characters, and also to allow for phylogenetic analyses including secondary chemistry.

Acknowledgements

The first author wants to thank the Dirección de Vida Silvestre, Servicio de Parques Nacionales, and the Organization for Tropical Studies for the permission to work and collect at La Selva. The field trip during which the material was collected was supported by a habilitation grant of the German Research Society (DFG; LU 597/3-1).

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MYCOTAXON

Volume LXXVIII, pp. 29-35 April-June 2001

NOTES ON HYPHOMYCETES. LXXXI. ACRODICTYELLA OBOVATA, A NEW LIGNICOLOUS, DEMATIACEOUS GENUS AND SPECIES COLLECTED IN ALABAMA

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ABSTRACT

A dematiaceous anamorph occurring on decaying, decorticated wood in Alabama is described as a novel, monotypic genus, *Acrodictyella,* with a new taxon, *A. obovata*, as its type species. It is compared with *Acrodictys* and *Ityorhoptrum,* two genera whose conidium ontogeny is broadly similar, in terms of cell wall relationships, and with which it shares certain morphological likenesses. It differs from these and other anamorph form-genera in subtle peculiarities of conidium detachment, particularly timing, and morphology.

KEYWORDS: *Acrodictys, Ityorhoptrum*, generic concepts.

INTRODUCTION

During the course of collecting dematiaceous Hyphomycetes occurring on dead, decorticated wood in the vicinity of Auburn, Alabama, a number of interesting and apparently hitherto unknown entities have recently been encountered. Among these is an anamorph which, when first examined, was thought to be an undescribed species of *Acrodictys* M.B. Ellis, a genus now comprising over thirty taxa but which has progressively become somewhat heterogeneous, as is the case in a number of other form-genera in this complex. Upon further consideration, however, although the fungus under study bears broad resemblance to anamorphs classified in *Acrodictys*, it has been determined to differ significantly in certain respects. The developmental and morphological discontinuities between it and *Acrodictys bambusicola* M.B. Ellis, the type species of *Acrodictys*, as well as some other members of that genus, are indeed such as to dictate its classification separately by placement in another genus. In addition to being broadly similar to *Acrodictys*, the novel taxon possesses some characteristics in common with *Ityorhoptrum* Kirk, but the differences between it and the latter genus are of a comparable dimension to those between it and *Acrodictys*. The newly-encountered anamorph is, therefore, accommodated in a new genus, and is described and illustrated herein.

TAXONOMIC PART

Acrodictyella W.A. Baker et Partridge gen. nov.

Coloniae effusae, pilosae, atrobrunneae vel nigrae, sparsae. Mycelium superficiale vel partim immersum, ex hyphis ramosis, septatis, pallide brunneis vel medio brunneis, laevibus, cylindricis vel torulosis compositum. Conidiophora macronemata, mononemata, singula vel caespitosa, ex apice lateribusque hypharum oriunda, simplicia, erecta, recta vel flexuosa, laevia, cylindrica, septata, olivaceo-brunnea vel atro brunnea, apicem versus pallidora, plerumque ad proliferationes successivas elongascienta, basi inflata. Cellulae conidiogenae in conidiophoris incorporatae, terminales, monoblasticae, subhyaliae vel pallide brunnae, indeterminatae, percurrentes. Conidia holoblastica, solitaria, sicca, acrogena, obovata, septis transversalibus et obliquus praedita, subhyalina vel pallide olivaceo-brunnea, laevia, ad basim truncata, secessio schizolytica.

Acrodictyella W.A. Baker & Partridge gen. nov.

Colonies effuse, hairy, dark brown to black, sparse. Mycelium superficial to partly immersed or, more often, predominantly immersed, composed of branched, septate, pale olivaceous brown to mid brown, smooth, cylindrical or somewhat torulose hyphae. Conidiophores macronematous, mononematous, single or gregariously caespitose in groups of two to three, arising terminally or laterally from usually swollen hyphal cells, simple, erect, straight to somewhat flexuous, smooth, cylindrical, septate, olivaceous brown to dark brown, thick-walled, paler toward the apex, elongating by successive proliferations, swollen at the base. Conidiogenous cells integrated, terminal, monoblastic, subhyaline to pale olivaceous brown, indeterminate, often with several percurrent proliferations. Conidia holoblastic, solitary, dry, acrogenous, obovoid, irregularly muriform, transversely and obliquely septate, sub-hyaline to pale olivaceous brown, smooth, distinctly truncate at the base, seceding schizolytically.

Etymology: *Acrodictys* et Lat. *ella*, diminutive.

Acrodictyella obovata W.A. Baker et Partridge sp. nov. (Figure 1).

Coloniae effusae vel diffusae, pilosae, olivaceo-brunneae ad atro brunneae vel nigrae. Mycelium superficiale ad partim immersum vel plerumque immersum, ex hyphis ramosis, septatis, pallide brunneis vel medio brunneis, laevibus, cylindricis vel torulosis, 3-5µm crassis compositum. Conidiophora macronemata, mononemata, singula vel caespitosa, ex apice lateribusque hypharum oriunda, simplicia, erecta, recta vel flexuosa, laevia, cylindrica, septata, olivaceo-brunnea vel atro brunnea, apicem versus pallidora, guttulata, parietibus crassis, plerumque ad proliferationes successivas elongascienta, usque ad 120µm longa, 6.5-7.5µm crassa, ad basim inflata, 8-10µm crassa. Cellulae conidiogenae in conidiophoris incorporatae, terminales, monoblasticae, subhyaliae vel pallide brunnae, indeterminatae, percurrentes. Conidia holoblastica, solitaria, sicca, acrogena, guttulata, obovata, septis transversalibus et obliquus praedita, subhyalina vel pallide olivaceo-brunnea, laevia, ad basim truncata, 8-10 × 7-9µm, secessio schizolytica.

In lignis putredinis, Auburn, Lee Co., AL, USA, 21 August 2000, W.A. Baker, AUA, holotypus.

Acrodictyella obovata W.A. Baker & Partridge sp. nov.

Colonies effuse, spreading widely over the substrate, hairy, olivaceous brown to dark brown or black, generally somewhat thin, with detached conidia appearing as shiny, translucent spheres around the apices of individual conidiophores. Mycelium superficial to partly immersed or, more often, mostly immersed in the substratum composed of branched, septate, pale olivaceous brown to mid-brown, smooth, cylindrical, 3-5µm wide hyphae. Hyphal elements often swollen and becoming torulose near the base of the conidiophores, sometimes forming rudimentary, stromata-like clusters. Conidiophores macronematous, mononematous, single or gregariously caespitose in groups of two to three, arising terminally or laterally from usually swollen, 4-6.5µm wide hyphal cells, erect, straight to somewhat flexuous, simple, septate, smooth, olivaceous brown to dark brown, each cell often once or twice guttulate, thick-walled, with occasional regenerative percurrent growth, up to 120µm long, 6.5-7.5µm wide, elongating by successive proliferations, slightly tapered and paler towards a 3.5-5µm wide apex, swollen at the 8-10µm wide base. Conidiogenous cells integrated, terminal, monoblastic, percurrent, sub-hyaline to pale olivaceous brown, indeterminate, often with several circumscissile annellations, extensions cylindrical, appreciably paler. Conidia holoblastic, solitary, dry, acrogenous, heavily guttulate when young, detaching before maturation and often remaining laterally appressed to the conidiophore periclinal wall following secession, at first somewhat cuneiform, becoming subglobose or, more often, obovoid, distinctly truncate at the base, smooth, irregularly muriform, transversely and obliquely septate, with the septa occasionally assuming a cruciate aspect, subhyaline to pale olivaceous brown when fully developed, 8-10 × 7-9μm in diameter, seceding schizolytically.

On decaying wood, forest along Chewacla Creek, west of Chewacla State Park, Auburn, Lee Co., Alabama, USA, 21 August 2000, W.A. Baker, AUA, holotype.

DISCUSSION

The decision to establish a new genus for the anamorph described above is based upon several unique characteristics that readily distinguish this fungus from morphologically similar genera. Certain peculiarities of conidium development and detachment in *Acrodictyella obovata* are unique, particularly the fact that the conidia secede well before maturation, in contrast to the condition exemplified in such genera as *Acrodictys* and *Ityorhoptrum* where conidia remain attached until more or less fully differentiated. At the time of secession the conidia of *A. obovata* remain hyaline and only become pigmented sometime following their release. When viewed under a dissecting scope liberated conidia can be seen in clusters at the tips of the conidiophores. Moreover, although the process of septation is initiated whilst conidia are still attached, septa are not fully laid down and do not become readily discernible until well after their release. In the details of cell wall relationships during conidiation, *A. obovata* closely resembles *Ityorhoptrum verruculosum* (M.B. Ellis) Kirk, the type species of *Ityorhoptrum*. The conidia of both these anamorphs bear a minute, circumscissile, marginal ridge at the extreme periphery of their truncate bases. In each case this is partly derived from the torn outer layer of the conidiogenous cell wall at the juncture of the delimiting transverse septum following schizolytic disarticulation, and partly from the splitting of a septal thickening which occurs immediately adjacent to the periclinal wall. The truncate base area within this ridge, derived as a half septum, remains appreciably thinner than the remainder of the conidium wall. In addition to this similarity, *A. obovata* resembles *Ityorhoptrum* in exhibiting occasional regenerative conidiophore growth not directly related to conidiation. Its conidiophores, however, are classic annellides in the manner of those of *Annellophora* S. Hughes.

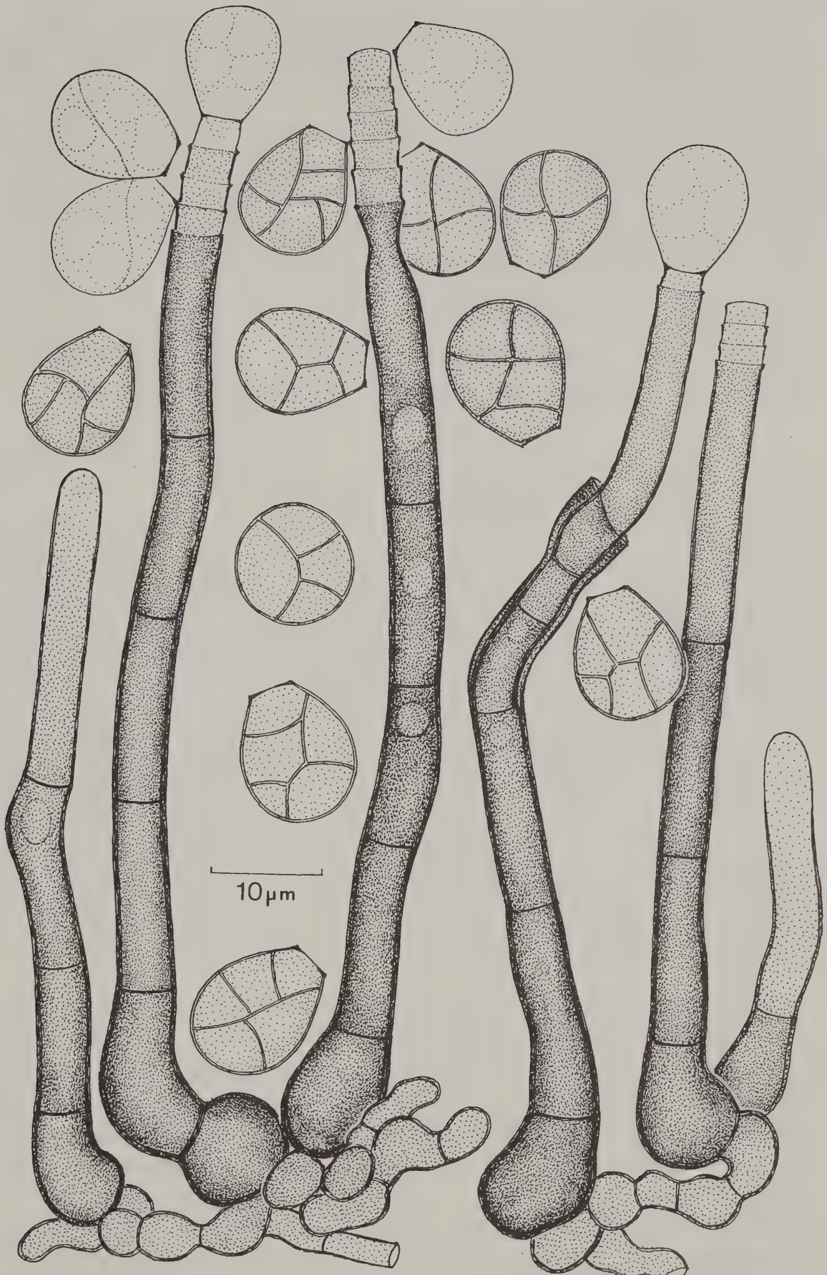

FIGURE 1. *Acrodictyella obovata*. Conidiophores and conidia.

Quite apart from conidiophore characteristics, the conidia of *A. obovata* are dissimilar in several respects to those of the type species of both *Acrodictys* and *Ityorhoptrum*. In the latter a basal obconical cell is present, delimited by a transverse septum oriented parallel to the truncate base, whereas in *A. obovata* the basal cell is variously shaped as a result of irregular, oblique septation. Moreover, in *Acrodictys bambusicola* the conidia become initially compartmentalized by primary transverse septa followed by secondary longitudinal or slighlty oblique septa. In contrast, the first septum formed in the conidium of *A. obovata* is usually obliquely placed, extending from a point to the side of the obtuse apex to a position a short distance above the truncate base. Another difference between *A. obovata* and *Acrodictys* species lies in the fact that the conidia are not constricted at the septa.

Among presently-accepted species of *Acrodictys*, *A. martinii* Crane & Dumont bears the most similarity to *Acrodictyella obovata*, particularly in that its conidia remain pale brown and are divided more or less cruciately by septa oriented at approximate right angles to one another. Likewise, some other taxa currently classified within *Acrodictys*, such as *A. brooksiae* M.B. Ellis, *A. obliqua* M. B. Ellis, and *A. queenslandica* Matsushima, do not have the regular septation pattern typical of the type species and a reevaluation of the rather broadly conceived circumsciption of the genus (Ellis, 1961; 1965) may, perhaps, be warranted. In this context, it should also be noted that species such as *A. brevicornuta* M.B. Ellis and A. *deightonii* M.B. Ellis, which have large, irregularly shaped conidia, extend the morphological range considerably beyond what have customarily been the limits set for generic delimitation within dematiaceous Hyphomycetes. Although something of a continuum exists, clear discontinuities occur within *Acrodictys* as presently constituted which are comprable to the features by which such genera as *Monodictys* S. Hughes and *Pithomyces* Berk. & Br. are distinguished.

The condition of a number of genera, *Acrodictys* among them, remains somewhat akin to that which existed in *Sporidesmium* Link, *sensu lato*, before the relatively recent establishment of a number of segregate genera, such as *Ellisembia* Subram., *Penzigomyces* Subram., *Repetophragma* Subram., and *Stanjehughesia* Subram. (Subramanian, 1992). Interestingly, some of the criteria upon which these taxa are based are similar in kind to those which distinguish *Acrodictyella* from morphologically comparable genera. With regard to possession of annellate conidiophores, *Acrodictyella* is analogous to *Repetophragma*, the truncate base of whose conidia also bear a marginal ridge. The latter characteristic has, incidentally, been referred to as a frill or fringe by some authors (Kirk, 1986; McKenzie, 1995). It is, however, quite different in type and derivation from the marginal, circumscissile, conidiogenous cell periclinal wall remnant which is typical of conidia detached rhexolytically. In contrast to the annellate condition exemplified in *Acrodictyella*, conidiophores of *Acrodictys* have either lageniform or doliiform terminal proliferations, a feature which typifies *Penzigomyces*, or do not exhibit percurrent growth, as is the case in *Stanjehughesia*. Although it is, perhaps, likely that most anamorphs currently classified in *Acrodictys*, as well as *Acrodictyella*, are phylogenetically related, some refinement of the taxonomy of this complex certainly seems desirable.

ACKNOWLEDGMENTS

We wish to thank Dr. Roger D. Goos, Department of Botany, University of Rhode Island, for providing a pre-publication review of the manuscript.

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MYCOTAXON

Volume LXXVIII, pp. 37-57 April-June 2001

MORPHOLOGICAL VARIABILITY AND IMPLICATION FOR DEINITION OF TAXA IN THE DESCOLEA-SETCHELLIOGASTER-DESCOMYCES COMPLEX

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ABSTRACT

Morphological continuums, which transgress traditional taxonomic boundaries, are expressed by many taxa within the *Descolea-Setchelliogaster-Descomyces* complex. We examine the contention that key macroscopic and microscopic characters traditionally used to distinguish some taxa of the complex are quantitatively variable components of the same taxon. We focus on *Setchelliogaster* and synonymize *S. rheophyllus* under *S. tenuipes*. Synonymy is necessary because form of basidioma/hymenium and occurrence of cystidia is highly variable within and between collections variously ascribed to these species. There is a direct relationship between the type of hymenial development and the abundance of cystidia. Other examples of high morphological variability within taxa of the complex are shown with *Descolea maculata*, *D. gunnii* and *S. australiensis*. Implications of variability in taxa include: (a) Generic names defined by basidiomal form are categories useful in a broad practical sense but may not be biologically distinct as their boundaries are transgressed by some taxa, e.g. *D. maculata* has forms typical of *Descolea* and *Setchelliogaster*. (b) Variations in basidiomal form expressed by taxa may be strong or weak. Broader species concepts than currently recognised are necessary for some species.

RESUMEN

Muchos táxones del complejo *Descolea-Setchelliogaster-Descomyces* muestran una continuidad morfológica en el basidioma que transgrede las delimitaciones taxonómicas clásicas. Se estudia la posibilidad de que caracteres clave macro y microscópicos, usados para distinguir táxones de este complejo, sean componentes variables en el mismo taxon. Se sinonimiza *Setchelliogaster rheophyllus* con *S. tenuipes*, debido a que la morfología del basidioma y del himenio y la presencia de cistidios son muy variables tanto a nivel de distintas colecciones como de la misma, encontrándose una relación directa entre el desarrollo himenial y la abundancia de queilocistidios. Se muestran otros ejemplos en: *Descolea maculata*, *D. gunnii* y *S. australiensis*. Las implicaciones de esta variabilidad son: (a) los nombres genéricos definidos en base a una morfología en el basidioma son categorías muy útiles en un sentido práctico, si bien no son distinguibles biológicamente, así estas delimitaciones son transgredidas por ciertos táxones, por ejemplo *D. maculata* con formas típicas de *Descolea* y *Setchelliogaster*, (b) las variaciones en la morfología del basidioma pueden ser mayores o menores según el taxon. Se necesita por lo tanto un concepto de especie más amplio que el habitualmente reconocido para algunos táxones.

KEYWORDS

Sequestrate fungi, species concept, cystidial abundance, *Eucalyptus* plantations, taxonomy.

INTRODUCTION

The *Descolea-Setchelliogaster-Descomyces* complex spans a broad range of basidiomal morphologies. Agaricoid forms traditionally are assigned to *Descolea,* secotioid forms to *Setchelliogaster* and gastroid forms to *Descomyces* (Beaton *et al*., 1985a b; Pegler and Young, 1987; Bougher and Castellano, 1993). Evidence that the three genera are closely related include some shared morphological characteristics of peridia/pileipelli, veils, spores, and mycorrhizas (Bougher and Malajczuk, 1985; Pegler and Young, 1987; Bougher and Castellano, 1993). Members of the complex are mostly mycorrhizal with *Eucalyptus*, other *Myrtaceae* and *Nothofagus,* and have a predominantly southern hemisphere natural distribution. Many of the fungi have become more widely spread in recent times in eucalypt plantations throughout the world, e.g. *Descolea maculata*, *Setchelliogaster tenuipes*, *Descomyces albus*.

Distinction of genera and species in the *Descolea-Setchelliogaster-Descomyces* complex has been traditionally based on basidiomal morphology. However, variability in basidiomal morphology expressed by the taxa can impinge upon concepts of their boundaries. Variable basidiomal morphology has been recognised in some taxa (Martín & Rocabruna, 1999), but the extent of variation in the complex is poorly known. A prime example concerns *Setchelliogaster rheophyllus* and *S. tenuipes* which are dominant sequestrate fungi in many European eucalypt plantations. The two species probably have an Australian origin. However, to date *S. rheophyllus* has not been reported in Australia and is known only in southern Europe and northern Africa. *S. rheophyllus* and *S. tenuipes* closely resemble each other and often co-occur in eucalypt plantations. Hence there has been some doubt about their distinction. Moreno *et al.* (1997) transferred *Naucoria rheophylla* Bertault & Malençon from *Descolea* to *Setchelliogaster,* and they pointed out the only two main differences with *S. tenuipes*: the more agaricoid basidiomal and the presence of lecythiform chelocystidia. However, in eucalypt plantations where *Setchelliogaster* basidiomata are abundant and where putatively *S. rheophylla* and *S. tenuipes* co-occur, a range of basidiomal morphologies often blur the distinction between agaricoid and secotoid forms. Martín & Rocabruna (1999) compared morphological and molecular characters of *S. tenuipes* and *S. rheophyllus* based on a collection of each of the two species simultaneously made at the same site in Spain. They concluded that *S. tenuipes* is probably recently derived from *S. rheophyllus* and that they are possibly morphotypes of the same species.

However these authors maintained the distinction between the two species based on the presence of cheilocystidia in *S. rheophyllus* but not in *S. tenuipes*.

In this study we examine a range of agaricoid and secotioid basidiomal forms variously ascribed to *S. rheophyllus* and *S. tenuipes* from Europe and elsewhere as a case study of basidiomal variability in the *Descolea-Setchelliogaster-Descomyces* complex. The aim is to test the hypothesis that key macroscopic and microscopic characters used to distinguish the species are quantitatively variable components of the same taxon rather than qualitatively variable components of different taxa. Additionally, we propose and examine the premise that morphological continuums, which transgress traditional taxonomic boundaries, are likely to be expressed by other taxa within the *Descolea-Setchelliogaster-Descomyces* complex.

MATERIALS AND METHODS

The macroscopical characters were obtained from fresh and dried material. The colour names are based on Kornerup & Wanscher (1981). For the microscopical study, details were taken from air-dried material rehydrated in 3% KOH and aqueous Congo Red. Samples were carefully taken from different portions of the hymenium, with special attention to gill-like margins, young and old pellis structures and the partial veil. Microscopical drawings were made with the aid of a camera lucida.

Common indices have been used for microscopical characterisation such as X (mean value of spore measures), E (quotient of length and width of the spores) and Q (mean value of E in all collections studied). Total number of collections and measured spores are designated by ‘N’ and ‘n’. The main spore range was obtained according to methodology of Breitenbach & Kränzlin (1991). Collections of basidiomata and cultures designated by 'E' or ‘H’ are lodged at the CSIRO Forestry and Forest Products Mycology Herbarium, Perth, Western Australia. Numbers designated by ‘T’ are currently held by Dr. J. M. Trappe, and by ‘C’ are currently held by Dr. A. W. Claridge. These collections are lodged variously at CANB, DAR, MELU, and OSC (as indicated). ‘B’ refers to G. Beaton’s herbarium (in MELU).

Basidiomata of *Setchelliogaster australiensis* were produced in pot cultures of *Eucalyptus globulus* and *E. urophylla* according to methods of Bougher *et al.* (1990).

RESULTS

1. Morphological variability in *Setchelliogaster tenuipes* and *S. rheophyllus*

Basidiomal morphology of *Setchelliogaster tenuipes* and *S. rheophyllus* varies from mainly agaricoid forms assigned to *S. rheophylla* to secotioid basidiomata assigned to *S. tenuipes*. However for both species agaricoid and secotioid basidiomata often occur together within the same collection, such as in the holotype of *S. tenuipes*. Furthermore exists a direct relationship between the type of hymenial development and the abundance of hymenial cystidia. In collections assigned to *S. tenuipes* with a mainly secotioid hymenophore the cystidia are strongly reduced and sometimes absent. However, in most of these collections, including the holotype of *S. tenuipes*, some cystida are present. In collections of *S. tenuipes* with some basidiomata with well developed gill margins, especially in more agaricoid examples, cystidia appear in such numbers that the margin is whitish (seen under hand lens).

Similar variations in the abundance of cystidia can also occur within the same basidioma. In some basidiomata, hymenial cystidia are present in parts where the hymenophore is gill-like (often near the base of the basidioma), but they are rare or absent where the hymenophore is loculate (often the upper region-Figure 1).

We conclude that *Setchelliogaster rheophyllus* and *S. tenuipes* are conspecific because the characters used to separate them - basdioma form and hymenial cystidia - are quantitatively variable and bridge across the boundaries of these species. We propose the following expanded description of *Setchelliogaster tenuipes*:

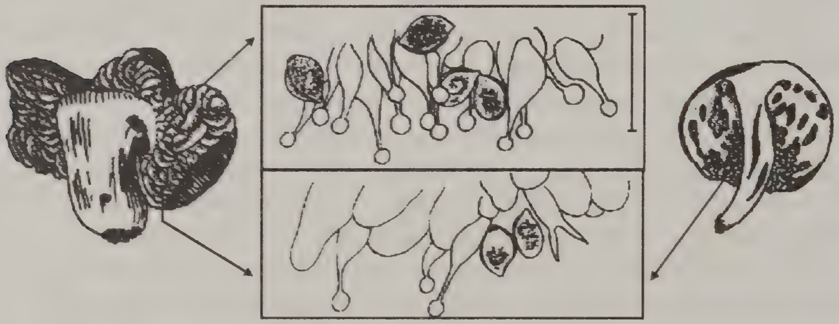


Figure 1. **Location of cystidia in *Setchelliogaster tenuipes*.** Differences in hymenial cystidium abundance in the same collection (H6264): on the left, agaricoid fruit body with different cystidium abundance related with the gill zone; on the right, secotioid form with scarce cystidia, located only at the gill-like hymenial margin. Scale bar 20 µm

Setchelliogaster tenuipes (Setchell.) Pouzar in Česká Mycol. 12: 34 (1958) Figures 2-16

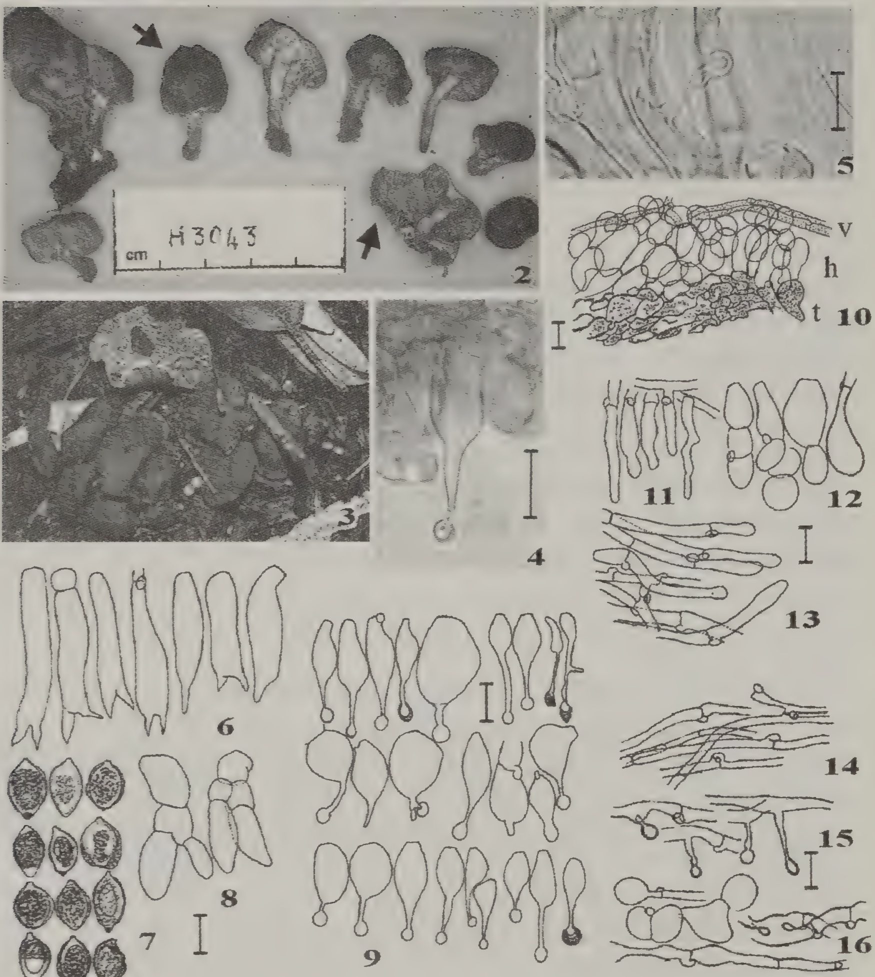
≡ *Secotium tenuipes* Setchell., *J. Mycol.* 13: 239 (1907) [*Basionym*]

= *Naucoria rheophylla* Bertault & Malençon in Malençon & Bertault, *Fl. Champ. Sup. Maroc* I: 427 (1970)

= *Descolea rheophylla* (Bertault & Malençon) Malençon, *Sydowia* 8: 258 (1979)
= *Setchelliogaster rheophyllus* (Bertault & Malençon) Moreno & Kreisel, *Feddes Repert.* 108(7-8): 568 (1997)

Pileus 0.5-4 cm broad, long ovoid when young or in secotioid forms, convex or broadly umbonate at maturity in agaricoid specimens (Figures 2-3), dark orange brown to violet brown (10E8) darkest at center and with radial orange brown to ruby (12E8) fibrils ; surface smooth and dry, sometimes strongly radially rugose, weakly hygrophanous; margin fibrillose in young basidiomata, paler coloured (pale yellow, 4A3), appendiculate and wavy in agaricoid forms. Hymenophore variable from radially loculate to crowded gill-like, anastomoses always present, dark orange (5B8), cinnamon, or rusty brown with a velvety-granulose appearance due to the spores, gill margin slightly pale and wavy. Stipe 1-3 x 0.2-0.6 cm, cylindrical or slightly tapering towards base, 2-3 times longer than pileus, thinner towards the base, pale yellow (4A3) or reddish brown coloured by longitudinal fibrils; ring evanescent, fibrillose, same coloured as cap margin. Veil fibrillose-arachnoid, pale yellow (4A3), easily observed in young or secotioid basidiomata. Flesh thin, pale yellow to yellowish brown. Basal mycelium hairy, pale yellow (4A3). Odour slightly hazelnut or not distinctive. Taste not distinctive.

Spores (Figure 7) ellipsoid to broadly amygdaliform, mainly symmetrical, yellowish brown, (11.2)12.6-18.6(21.7) x (6.7)7.6-11.6(13.8) µm, mean 15.6±1.5 x 9.6±1.0 µm, E = (1.1)1.3-2(2.4), Q = 1.6 (n =1239, N = 36), with a straight hilar appendix and a broad, darker coloured callus region, exosporium hyaline, warted, loose, never covering the smooth apex. Basidia (Figure 6) cylindrical, thinner towards the base, sometimes with a medial constriction, 28-50 x 8-12.5 µm (n =97, N =29), 1-2 spored, with conical, straight to slightly curved sterigmata up to 10 µm long, basal clamp connection present. Cheilocystidia (Figures 4, 9) sometimes thick-walled, 18-46 x 7.2-23 µm (n =110, N =32), lecythiform, with a wide base and subglobose head, 4.8-7.1 µm long, mainly present in the gill-like margins. Pleurocystidia not observed. Subhymenium (Figure 8) formed by branched hyphae with short isodiametric cells, with clamp connections.. Hyphal trama parallel, of long, cylindrical, pale yellow to brown pigmented hyphae, 4-12.4 µm broad, with clamp connections. Pileipellis (Figures 10, 12) with two layers: outer one an epithelium 38-54 µm broad, comprised of subspheric to claviform cells 10.4-32.3 x 10-20 µm; inner layer of parallel hyphae strongly encrusted incrusted with brown pigment and scarcely branched, 3.2-12 µm broad; veil remnants (Figure 10) present in some collections, formed by parallel, pale coloured, thin-walled hyphae, 4-8 µm diameter. Stipe pellis with parallel, brownish yellow hyphae, 3.2-8 µm broad. Caulocystidia



Figures 2-16. **Macro and microscopical featuresof *Setchelliogaster tenuipes*.** Fig. 2 collection H3043 from California, with arrows pointing to an agaricoid and a secotioid basidioma (left and right, respectively) occurring within the same collection; Fig. 3 agaricoid basidiomata prevalent in collection LOU15333 from Spain; Fig. 4 hymenial cystidia in Congo red, collection H7583; Fig. 5 capitate elements in veil remnants on the stipe, collection H7582. Fig. 6 basidia, Fig. 7 spores, Fig. 8 subhymenium and protobasida, Fig. 9 hymenial cystidia, Fig. 10 section of pileipellis: v veil remains, h epithelial layer, (t. trama layer, Fig. 11 caulocystidia, Fig. 12 pileipellis elements, Fig. 13 hyphae of annulus region, Fig. 14 hyphae emanating from the base of the stipe, Fig. 15-16 capitate elements and various hyphae of the arachnoid veil. Scale bar 10 µm.

(Figure 11) scarce, cylindrical to subcaptitate or claviform, 20-36 x 4.5-8 µm (n =9, N =2), sometimes brown encrusted. Annulus (Figures 13) composed of parallel, poorly branched, weakly coloured, hyphae, 3.2-9.8 µm diameter, with acute to swollen, rounded hyphal ends, also with some celulodermic elements (Figure 16) and capitate elements (Figures 5, 15). Basal mycelium of thin, pale coloured hyphae, 2.4-5 µm diameter, poorly branched, with closed and open anastomoses.

Habitat and distribution: *Setchelliogaster tenuipes* is a mycorrhizal associate of *Eucalyptus* species and other members of *Myrtaceae* such as *Leptospermum* (Beaton *et al.,* 1985b) in Australia and overseas. Also, there is one report under *Acacia* (Dr. M. Bon, personal communication). It frequently appears in small groups, sometimes confluent, under leaves and bark, partially emerging above the ground. This species produces basidiomata mainly in winter, November to March in Spain and elsewhere in the northern hemisphere, and May to August in Australia. *S. tenuipes* is widely distributed in natural eucalypt ecosystems in Australia and has been introduced into eucalypt plantations in many parts of the world (Figure 17).

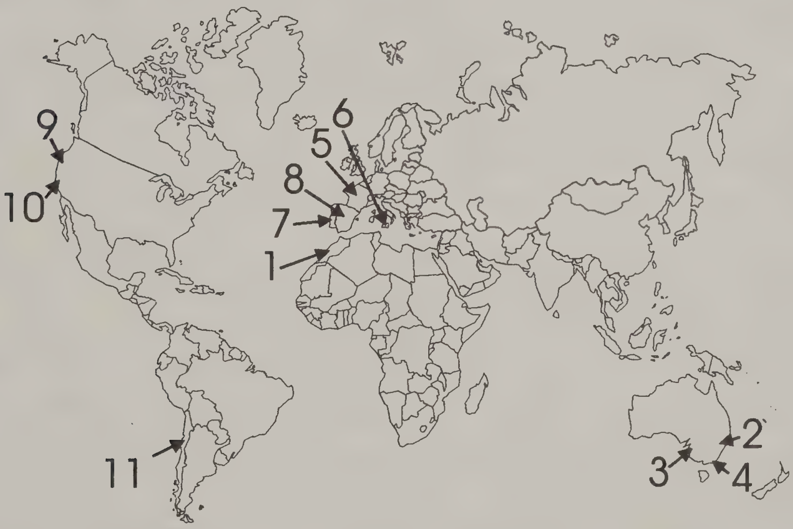


Figure 17. Distribution of *Setchelliogaster tenuipes* based on citations and the current authors' contributions. Indicated in bold are: **Africa**: 1) Morocco (Malençon & Bertault, 1970); **Australia**: 2) New South Wales (present authors), 3) South Australia (present authors), 4) Victoria (Beaton *et al*., 1985b); **Europe**: 5) France (Dr. M. Bon, personal communication), 6) Italy (Pacioni & Lalli, 1984; Moreno *et al*., 1997), 7) Portugal (present authors), 8) Spain (Calonge, 1995; Esteve-Raventós *et al.,* 1997; Moreno *et al*., 1997; Martín & Rocabruna, 1999), **North America**: USA: 9) Oregon (Singer & Smith, 1959), 10) California (Pouzar, 1958; Singer & Smith, 1959, Thiers & Watling, 1971), **South America**: 11) Chile (Lazo, 1972).

Collections examined: **AUSTRALIA: New South Wales:** Forbes-Cowra Highway, 0.25 km SE of Innisfail Lain, under *Eucalyptus microcarpa,* 26/8/1999, J. M. Trappe, H7587, T24747 (DAR). Hartley Vale, SE of Lithgow, 23/8/1999, J. Trappe, H7584, T24512 (MELU). Highway 90, 5 km West of Bucoda Road Junction, under *Eucalyptus macrorhyncha, E. polyanthemos* and *E. sideroxylon,* 25/8/1999, T. Lebel, H7586, T24647 (DAR). Mitchell Highway, 4.6 km E of Milthorp Road Juction at Roadside rest area, 23/8/1999, T. Lebel, H7580, T24524 (MELU). Nangar National Park, Mogong Cr., under *Eucalyptus polyanthemos*, *E. macrohyncha*, *E. microcarpa* and *E. albens,* 26/8/1999, T. Lebel, H7581, T24715 (MELU). Nangar National Park, Mogong Cr., under *Eucalyptus polyanthemos* and *E. macrohyncha* with grass groundcover, 26/8/1999, J. Trappe & T. Lebel, H7582, T24719 (DAR). Nangar National Park, Mogong Cr., 2 km West of East entrance, under *Eucalyptus sideroxylon* and *E. macrorhyncha* with a grass ground-cover, 29/8/1999, J. Trappe & A. Claridge, H7585, T24776 (CANB). Parkes-Eugowra Highway, 1 km W of East Forest Rd (Back Yamma State Forest), under *Eucalyptus albens,* 25/8/1999, J.Trappe, T. Lebel & M. Castellano, H7583, T24686 (CANB). **South Australia**, Kuiipo, 30 km SE of Waite, 1972, J. Warcup, H692. **Victoria**, Eildon-Jamieson road, Big River bridge, epigeal under *Leptospermum derbris*, 20/8/1983, R.Beever & G.Beaton, B91. **ITALY: Sardinia**, Oristano, "Palmas arborea", under *Eucalyptus camaldulensis*, 6/3/1989, T6128. **PORTUGAL**: **Minho**: Viana do Castelo, Mount Santa Luzia, under *Eucalyptus globulus*, 31/1/1998, M. Lago & E. Luis, LOU15334. **SPAIN**: **A Coruña**: Ferrol, Doniños, under *Eucalyptus globulus*, 23/2/1997, M. Lago & M. Aneiros, LOU15328. **Lugo**: Quiroga, Quiroga, under *Eucalyptus macarthurii*, 22/11/1997, M. Lago & E. Luis, LOU15330. Viveiro, Chavín, under *Eucalyptus delegatensis*, 29/11/1997, M. Lago & E. Luis, LOU15336. **Ourense**: Boborás, Train station, under *Eucalyptus globulus*, 22/11/1997, M. Lago & E. Luis, LOU15331. Verín, way to Alto de Fumaces, under *Eucalyptus rudis*, 24/12/1997, M. Lago, LOU15333. **Pontevedra**: Cangas, Barra, under *Eucalyptus globulus*, 19/1/1997, M. Lago & J. Blanco, LOU8977. Moaña, Domaio, way to Mount Xaxán, under *Eucalyptus globulus*, 27/12/1997, M. Lago & E. Luis, LOU15336. O Grove, A Toxa Island, under *Eucalyptus globulus*, 25/1/1998, M. Lago & E. Solís, LOU15332. Pontevedra, A Xunqueira, under *Eucalyptus globulus*, 16/11/1995, M. Lago & D. Solís, LOU3695. Pontevedra, CIF Lourizán, under *Eucalyptus ficifolia*, 10/2/1998, M. Lago, LOU15335. Redondela, Rande, under *Eucalyptus globulus*, 13/3/1995, J. Rodríguez, LOU3973. Vigo, Cíes Islands, Monteagudo Island, under *Eucalyptus globulus*, 29/1/1999, M. Lago, LOU15329. Vigo, Saians, under *Eucalyptus globulus*, 20/11/1995, M. Lago & E. Luis, LOU8662. **USA**: **California**: Berkeley, under *Eucalyptus sp*, 12/12/1904, N. Gardner, UC221827 (ISPOTYPE). Contra Costa County, City of Richmond, Hoftman road, under *Eucalyptus sp.* and *Acacia sp.*, 30/3/1985, M. Wood, D. Luoma, M. Castellano & Y. Wang, T8498 (OSC). Glenn County, Rest stop North of Willows on I-5, under *Eucalyptus globulus*, 25/3/1989, D. Luoma, T8417 (OSC). Humboldt County, McKinleyville, under *Eucalyptus sp* and *Acacia* sp., 6/3/1989, M. Castellano, D. Luoma, H. Massicotte & L. Tackaberry, T11075 (OSC). Humboldt County, North of Eureka, Westside of Highway 101, near Arcata Redwood County, under *Eucalyptus sp.*, 18/1/1985, M. Castellano, T8362 (OSC). Humboldt County, Albion bridge, under *Eucalyptus globulus*, 7/3/1989, M. Castellano, D. Luoma, H. Massicotte & L. Tackaberry, H6264, T11081 (OSC). Marin County, Junction of Panoramic Highway and Shoreline Highway (North of San Francisco), under *Eucalyptus globulus*, 10/4/1991, N. Bougher, M. Castellano & D. Luoma, H3043, T11756 (OSC). Idem, N. Bougher, H3049, T11757 (OSC). Mendocino County, Albion, north-side of bridge, under *Eucalyptus globulus*, 7/3/1989, M.A. Castellano, D. Luoma, H. Massicotte & L. Tackaberrry, T11081 (OSC). Mendocino County, NSF Plot, under *Eucalyptus globulus*, 6/3/1989, M. Castellano, L. Tackaberry & D. Luoma, T11069 (OSC). Mendocino County, South of Albion, at Albion River Bridge, West of Highway 101, under *Eucalyptus sp.*, 16/1/1985, P. Luoma, M. Castellano, Y. Wang & S. Berch, T8367 (OSC). San Francisco State University campus, under *Eucalyptus globulus*, 30/11/1987, N. Malajczuk, H3016. Sonora County, Kruse Rhododendron Park, under *Eucalyptus globulus*, 17/1/1985, D. Luoma, T8375 (OSC). Sonora County, Kruse Rhododendron Park, under *Pseudotsuga menziesii* and *Eucalyptus globulus*, 31/3/1989, H. Saylor, Y. Wang, D. Luoma & M. Castellano, T8408 (OSC).

Related species: At present, *Setchelliogaster* comprises six known species: *Setchelliogaster aurantiacum* (Zeller) Singer & Smith represented only by the original collection in Cuba (Zeller, 1947), *S. australiensis* Beaton, Pegler & Young from south-east Australia (Beaton *et al.*, 1985a), *S. brunneus* (Horak) Singer from Chile and Argentina (Horak, 1979), *S. fragile* (Zeller & Dodge) Horak from Chile and Argentina (Horak, 1979), *S. rheophyllus* (Bertault & Malençon) Moreno from Morocco, Italy and Spain (Malençon & Bertault, 1970; Pacioni & Lalli, 1984; Moreno *et al.*, 1997), and *S. tenuipes* (Setchell.) Pouzar from USA, Australia, Chile, Spain and Italy (Pouzar, 1958; Beaton *et al.*, 1985b; Lazo, 1972; Vidal, 1994; Migliozzi & Coccia, 1987).

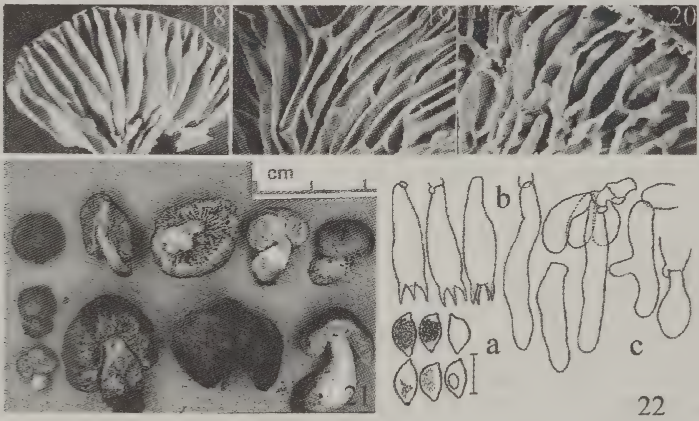
The closest relative to *S. tenuipes* is the South American species *S. brunneus* (Horak) Sing. (based on our examination of the isotype - ZT 64/17). It has 2-(4) spored basidia, 23-34 x 8-9 µm, and large symmetrical spores, 16-22 x 9-11,5 µm, with a loose exosporium, no hymenial cystidia and occurs under *Nothofagus* (Horak, 1963; Horak, 1979; Raithelhuber, 1987). However, few collections of this species are currently available for study and examination of more collections are required to assess affinities between the two species.

Horak *et al.* (1996) described *Descolea alienata* under *Acacia* trees in Hawaii. *D. alienata* and *S. tenuipes* are the only known species with lecythiform cystidia within the genera *Descolea* and *Setchelliogaster*. Microscopically, the two species do not differ and only macroscopical characters differentiate them: *D. alienata* with agaricoid morphology, a weakly rugulose-wrinkled surface and a membranous annulus. *D. alienata* may be a close relative of *S. tenuipes,* representing an agaricoid form. Molecular data may be required to test this hypothesis.

2. Morphological variability in *Descolea maculata*: secotioid and agaricoid basidiomata

Descolea maculata Bougher in Bougher & Malajczuk, *Aust. J. Bot.*, 33: 619-627 (1985).
Figures 18-22

Descolea maculata has been circumscribed as agaricoid in Australia and elsewhere (Bougher & Malajczuk, 1985; Moreno *et al.,* 1994). However, recent collections (E4441 and LOU15366) show a transition between agaricoid and secotioid forms. Collection E4441 (Figure 21) consists of secotioid basidiomata: hymenophore gleba-like with contorted lamellae with abundant anastomoses and enclosed by a strongly convex pileus. A partial veil covers the hymenium at maturity, and the stipe has a bulbous base. A membranous annulus (typical of agaricoid forms of *D. maculata*) is absent. Collection LOU15366 (Figures 18-20) represents a transition between the more common agaricoid form of *D. maculata* and the sequestrate form of E4441. It has subhypogeous basidiomata with robust, short stipes and the pileus expand. The lamellae are well formed but have abundant anastomoses, especially around the stipe. A membranous annulus is absent in some basidiomata and replaced by fibrillose or disorganised membranous tissue. Unlike *S. tenuipes*, variation in the basidiomal morphology does not correspond with variation in microscopical characters (Figure 22). In both collections (E4441 and LOU15366), all major microscopical characters fall within the currently accepted variation range of *Descolea maculata* (Table 1).



Figures 18-22. **Secotioid and transitional forms in *Descolea maculata*.** Figures 18-20: Basidiomal plasticity in the same collection (LOU5366): Fig. 18 radially arranged lamellae typical of agaricoid basidiomata, with the lamella margin uniform and unbroken, Figure 19 lamellae with some anastomoses and some radilly elongated locules, and with the margin mainly uniform, Figure 20 lamellae with frequent anastomoses and labyrinthine locules, and with margins broken and discontinuous. Figure 21 secotioid basidome forms of *D. maculata* in collection E4441, Figure 22 typical hymenial structures in collection E4441. (a) basidia, (b) cystidia and sterile elelments, (c) spores. Scale bar 10 μm

Collections examined: **AUSTRALIA**: **Tasmania**: Mount Wellington, picnic area, 17/5/1991, M. Trappe, M. Castellano & N. Bougher, E4441; **Western Australia**: Perth, Floreat Park, in glasshouse pots with *Eucalyptus diversicolor* and *E. marginata*,

Character	HOLOTYPE	LOU15366	E4441
Basidioma	agaricoid, epigeous	mainly agaricoid, subhypogeous	secotioid, subhypogeous
Pileus	convex to hemispherical appressed squamules present	convex to hemispherical fibrillose squamules present	mainly convex, including at maturity fibrillose squamules present?
Hymenophore	Lamellate, lamellulae present, no anastomoses	lamellate, anastomoses present, especiallly close to the stipe	gleba-like, inner part loculate, outer part contorted-lamellate with abundant anastomoses
Stipe	cylindrical, sometimes tapered towards apex annulus membranous and striate	short and robust, swollen towards base annulus membranous, sometimes absent, not striate	thick, with a wide base sometimes bulbous membranous annulus absent, only fibrillose remnants
Spores	amygdaliform to sublimoniform, minutely verrucose, asymmetrical and mucronate 10-13 x 6-7.5 µm, mean 11.4 x 6.6 µm (n =20)	amygdaliform to sublimoniform, minutely verrucose, asymmetrical and mucronate 9.4-13.1(13.6) x 5.5-8.1 µm, mean 11.3 x 6.8 µm (n =34)	amygdaliform to sublimoniform, minutely verrucose, sometimes almost smooth, asymmetrical and mucronate 10.8-14(14.5) x 6-8.3 µm, mean 12.4 x 7.2 µm (n =37)
Basidia	28-40 x 8-15 µm, 4-spored	28-36 x 6.4-9.6 µm, (2)4-spored	32-33 x 10.4-12 µm, 4-spored
Cheilocystidia	clavate	clavate to cylindrical	clavate to cylindrical
Pileipellis	epithelium with clavate terminal cells, veil remnants present	epithelium with clavate terminal cells, veil remnants present	epithelium with clavate terminal cells, sometimes cylindrical, veil remnants present

Table 1. Comparison of morphological characters in agaricoid and secotioid collections of *Descolea maculata.* Data for Holotype (PERTH915645) from Bougher and Malajczuk (1985).

17/5/1983, N. Malajczuk, PERTH915645 (HOLOTYPE). **SPAIN**: **Pontevedra:** Vigo, Cíes Islands, Monteagudo Island, under *Eucalyptus globulus*, 29/1/1999, M. Lago, LOU15366.

3. Morphological variability in *Descolea gunnii*: secotioid and agaricoid basidiomata.

Descolea gunnii (Berkeley in Massee) Horak, *Persoonia* 6(2): 242-243 (1971)

≡ *Secotium gunnii* Berkeley in Massee, *Grevillea* 19: 96 (1891) [*Basionym*]

= *Gymnoglossum gunnii* (Berkeley) Cunningham, *New Zealand J. Sci. Techn.* 22: 300B (1941)

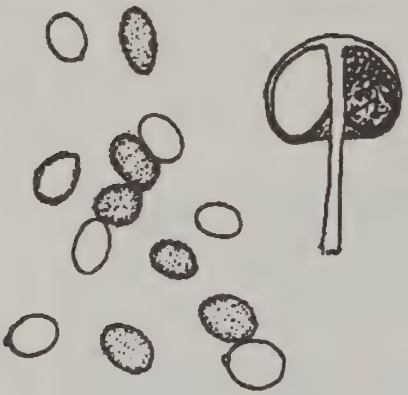


Figure 23. **Original drawing of *Secotium gunnii*** showing the secotioid basidiomal morphology; taken from Berkeley in Massee (1891: 96).

Another example of secotioid and agaricoid basidiomal forms in *Descolea* is *D. gunnii* (Berk.) Horak. The original diagnosis of this species is based on a secotioid basidioma (Figure 23). *Secotium gunnii* Berkeley in Massee, *Grevillea* 19: 96 (1891) was described in New Zealand as having sequestrate basidiomata with a polygonal gleba, columella and a small stipe. Later Cooke (1892) mentioned the same species with secotioid morphology in Tasmania, but the description provided is a duplicate of Berkeley's description. Cunningham (1924) corroborated the original diagnosis, but later (Cunningham, 1941) transferred the species into *Gymnoglossum* due to the presence of a branched columella not separable from the gleba. Finally, Horak (1971) transferred *Secotium gunni* into the agaricoid genus *Descolea* Singer, based on the microscopical characters and the presence of a striate ring in the 'poorly preserved collection'. Unfortunately, in the description of this new combination the author did not consider the possibility of secotioid basidiomata in the same species, probably because the specimens available for examination were broken into fragments.

As is the case with *Descolea maculata*, sequestrate basidiomata of *D. gunni* do not differ microscopically from agaricoid basidiomata.

4. Morphological variability in *Setchelliogaster australiensis*

As is the case with *Setchelliogaster tenuipes*, variation in basidiomal morphology is evident in *S. australiensis*. However we have not observed agaricoid forms in *S. australiensis* - all collections examined had sequestrate basidiomata (Figures 24-27). These range from stipitate basidiomata with exposed or enclosed hymenium to more gastroid forms with a poorly differentiated stipe. The pileipellis surface varies from velvety to cracked or smooth. This can occur with the same strain in different environmental conditions, e.g. H5957 (e.g. basidiomata from the field in Queensland and basidiomata raised in glasshouse pots, compare Figures 24 and 25). The hymenophore structure is not as variable as in *S. tenuipes*, and is consistently loculate with radial or labyrinthine arrangement, however the stipe varies from a short, easily disconnected, sterile base without a percurrent columella to a well differentiated, thick, bulbous stipe with a broad percurrent columella.

Spore morphology and size vary highly in *S. australiensis* (Figure 29, 33). The isotype represents only a small portion of the variability. Collections obtained from the same strain (H1023) grown under different conditions vary strongly in spore size (Figure 33, indicated by arrows). However, a relationship of basidiomal morphology with spore size and shape is not apparent, e.g. larger spores occur in some stipitate and some non-stipitate basidiomata.

Setchelliogaster australiensis is another example of variable basidiomal morphology in the *Descolea-Setchelliogaster-Descomyces* complex. To account for this variation we expand the description of this species as follows.

Setchelliogaster australiensis Beaton, Pegler & Young, *Kew Bull.* 40: 169 (1985)

Figures 24-32

Basidioma (Figures 24-27) secotioid, 0.5-2 cm diameter, convex at first then ellipsoid with a broad flattened apex. Pileus dry, light orange (5A5), yellowish brown or orange brown to reddish golden (6C7) uniformly colored at first, becoming orange (6A6) to dark brown (8F8) from center outwards and mottled, squamulose with fibrillose scattered scales which are evanescent, sometimes cracked or split with age. Margin strongly incurved initially when appressed against stipe, then separating from the stipe with hymenium exposed or hidden by a fibrillose-membranous, persistent, light orange (5A4) veil. Hymenophore adnate with columella, upper portion labyrinthoid with small irregular chambers, lower portion radially sublamellate with gill-like anastomoses, pale yellowish white (2A2) to reddish golden (6C7). Columella present or absent, if present concolorous with hymenium, polymorphic varying from a single percurrent columella continuous with the emergent stipe to a reduced network of narrow bands originating from the base of the hymenium. Stipe always present, 0.3-1.3 x 0.3-0.4 cm, emerging up to 0.8 cm beyond hymenophore, central, solid and dry, polymorphic, cylindrical to clavate and sometimes bulbous, covered with brown velar material when young but soon paler (5A6 Melon yellow), easily detached. Flesh whitish in the columella to brownish at base of stipe. Basal mycelium pale orange. Odour not conspicuous. Taste mild.

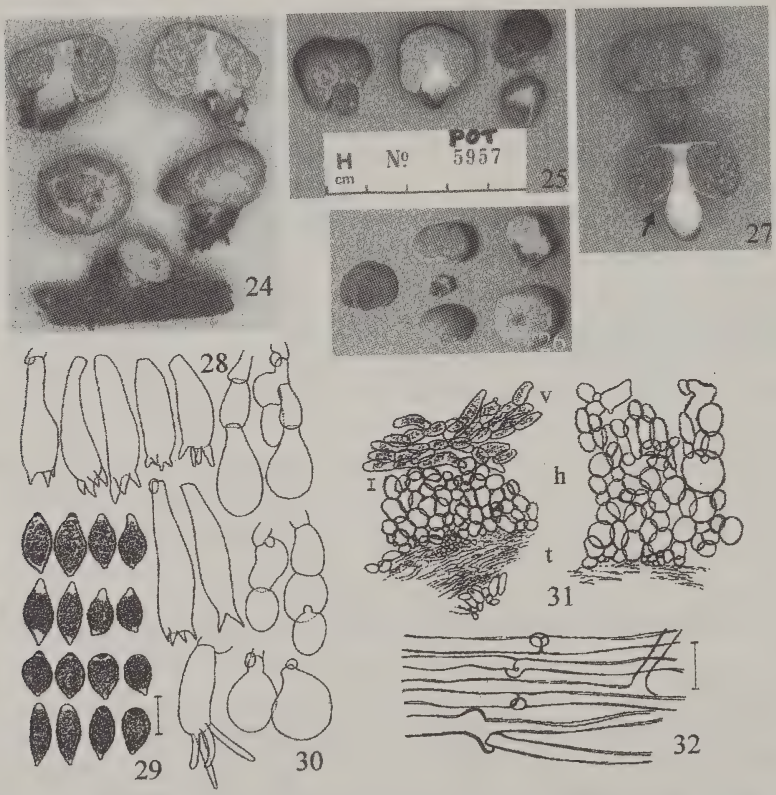


Figure 24-32. **Macro and microscopical features of *Setchelliogaster australiensis.*** Figures 24-27 fruit body plasticity: Fig. 24 secotioid basidiomata in collection H5957 from Queensland, Fig. 25 basidiomata raised in glasshouse pot conditions in Perth, Western Australia after inoculation of *Eucalyptus* species with a pure isolate of H5957, Fig. 26 slender basidioma with the hymenium covered with veil (arrow) in collection H5922, Fig. 27 strongly sequestrate basidiomata in collection H1023 from Tasmania. Figures 28-32: microscopical feature: Fig. 28 basidia, Fig. 29 spores, Fig. 30 subhymenium and basidioles, Fig. 31 section of pileipellis in a younger basidioma (left) and an older one (right) in collection H5957: v. veil remains, h. epithelial layer, t. trama layer, Fig. 32 hyphae from arachnoid veil on the hymenium. Scale bar 10 µm

Spores (Figure 29) mainly asymmetric, amydaliform to subfusoid, (8.3)11-18.3(20.8) x 6.3-9.9(11.7) µm, mean 14.7±1.8 x 8.1±0.9 µm, E =1.3-2.3(3.1), Q =1.8, n =1170, N =28, brownish yellow, minutely verrucose except at the apex which is sometimes strongly mucronate, hilar appendix short and acute. Basidia (Figure 28) cylindrical to clavate, 25-50 x 6.3-12.5 µm (n =56, N =18), 4-spored with mainly acute sterigmata up to 8.3 µm, basally clamped. Hymenial cystidia absent. Basidioles (Figure 30) clavate to broadly clavate. Hyphal trama of parallel hyphae, weakly brown pigmented, 2-12 µm diameter, clamped. Subhymenial layer with isodiametric elements, 6-21 µm diameter, hyaline. Pileipellis (Figure 31) a cellulodermic layer 30 to 190 µm thick, with claviform to subsphaerical, brown encrusted, elements, 17-70 x 15-32 µm over a compacted, brown trama. Veil remains present on the pellis in young specimens, up to 100 µm thick, with parallel moderately pigmented hyphae, sometimes with swollen elements, 10-30 µm diameter. Veil over the hymenium (Figure 32) with the same structure but less or non-pigmented. Veil remains over the stipe in young specimens, composed by straight, golden hyphae, 15-22 µm diameter, thick-walled and poorly branched.

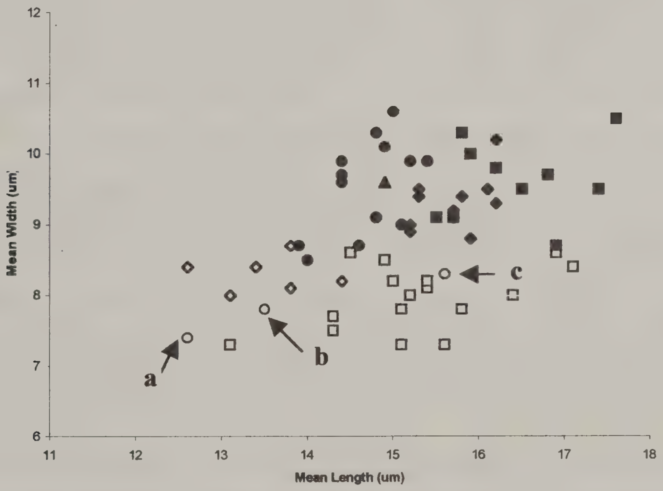


Figure 33 **Diagram of basidiospore sizes (means per collection) in *Setchelliogaster tenuipes* and *S. australiensis*.** Collections of *S. australiensis* are indicated by outlined symbols: squares for collections from NSW and Victoria; rhomboids for collections from Queensland. Circles indicated by arrows represent field-collected basidiomata of H1023 from Tasmania (a) and basidiomata subsequently raised in Western Australia in glasshouse pots with *Eucalyptus* species inoculated with a pure isolate of H1023: glasshouse (b) and plantation (c). Collections of *S. tenuipes* are indicated by solid symbols: squares for collections from Australia; rhomboids from Portugal and Spain; triangles from Italy, and circles from California.

Habitat and distribution: *Setchelliogaster australiensis* occurs with *Eucalyptus* species in eucalypt forests in eastern Australia from Queensland to Tasmania, sometimes mixed with *Acacia*, *Nothofagus* and *Podocarpus*. It also occurs in eucalypt plantations, including one isolate introduced from Tasmania into a *Eucalyptus globulus* plantation in Western Australia (see collections below).

Related species: The closest species to *Setchelliogaster australiensis* may be *Setchelliogaster fragilis* (Zeller & Dodge) Horak from Chile and Argentina This species has 4-spored basidia and symmetric, limoniform spores, 12-15 x 7-8 µm (Horak, 1979). However direct examination of *S. fragilis* is required to resolve the question of its relationship to *S. australiensis*, as it is described with a two-layered pileipellis composed by cylindrical hyphae. Such a structure is not typical of the genus *Setchelliogaster*.

Collections examined: **AUSTRALIA**: **New South Wales**: Glenugie State Forest, under *Eucalyptus sp*., 2/4/1992, N. L. Bougher, H5922. Mount Kosciusko National Park, on ridge SW of Charlotte Pass, under *Eucalyptus niphophila*, 25/4/1999, J. Trappe, H7589, T24023 (DAR). **Queensland**: 4km West of Mount Glorious, under *Eucalyptus sp*., 4/5/1992, M. Castellano, H5957. 5km West of Mount Glorious, under *Eucalyptus sp*., 4/5/1992, M. Castellano, H6009. 9km West of Mount Glorious, under *Eucalyptus sp*., 4/5/1992, M. Castellano, H5986. Brisbane State Park, under *Eucalyptus sp*., 7/5/1992, J. Trappe, H6139. Brisbane State Park, under *Eucalyptus sp*., 7/5/1992, J. Trappe, H6118; **Tasmania**: West of Maydena, under *Nothofagus cunninghamii* and *Eucalyptus regnans*, 16/5/1991, N. Malajczuk, H5248. Lone Star Provenance Trial, under 9 years old *Eucalyptus globulus* plantation, 10/7/1986, N. Malajczuk & T. Burgess, H1023. **Victoria**: Apollo Bay, end of Turtoas Track, hypogeal partially exposed under *Eucalyptus* forest litter, 19/7/1982, K. & G. Beaton, B39 (MELU) (Isotype). Beachamp Falls, Otway State Forest, under *Eucalyptus regnans*, *Acacia melanoxylon* and *Nothofagus cunninghamii*, 4/5/1995, N. Bougher, R. Vilgalys, S. Bolsenbroek & M. Brundrett, H7125. East Gippsland, Mount Hotham, Track to Mount Loch, under *Eucalyptus niphophila*, 9/5/1999, J. Trappe, H7588, T24028 (OSC). Lake Tyers Forest Park, Burnt Bridge Rd, 2.9 km south of junction with Princes Hwy, under *Eucalyptus cypellocarpa, E. globoidea*, 9/5/1999, J. Trappe, H7593, T24048 (OSC). Errinundra Road, 5 km before Information Hut in Errinundra National Park, under *Eucalyptus nitens*, *E. regnans* and *Podocarpus sp*., 27/4/1995, M. Brundrett, H7065. Idem, S. Bolsenbroek, H7054. Errinundra National Park at Goonmirk Rocks, under *Acacia dealbata, Eucalyptus delegatensis* and *E. nitens*, 27/5/1999, A. Jumpponen., T. Lebel, G. Mires & A. Claridge, H7592, C2621 (CANB). Errinundra National Park, Goonmirk Road, 0.4 km NE Track to Goonmirk Rocks, under *Acacia dealbata, Eucalyptus delegatensis* and *E. nitens*, 27/5/1999, J. Trappe, H7595, C2631 (MELU). Errinundra National Park, Junction of Aspen Battery Track and Goonmirk Rocks Road, under *Eucalyptus nitens* and *Acacia dealbata*, 27/5/1999, J. Trappe, A. Jumpponen., T. Lebel, G. Mires & A. Claridge, H7594, C2606 (MELU). Errinundra National Park, Junction of Coast Range Road and Goonmirk Rocks Road, under *Acacia dealbata* and *Eucalyptus nitens*, 27/5/1999, A. Jumpponen, H7599, C2675 (CANB). Errinundra Road, Errinundra National Park, East Gippsland, under *Eucalyptus regnans* and *Eucalyptus spp*, 27/4/1995, N. L. Bougher, H7067. Maits Rainforest Walk, Otway National Park, under *Eucalyptus regnans* and *Nothofagus cunninghamii*, 3/5/1995, N Bougher, R. Vilgalys, M. Brundrett & S. Bolsenbroek, H7102. The Gap Scenic Reverve, Gap Road, 2.1 km W Junction Track to Result Creek, under *Acacia dealbata, A. melanoxylon* and *Eucalyptus fastigata*, 27/5/1999, A. Claridge, G. Mires & T. Lebel, H7596, C2679 (MELU). The Gap Scenic Reserve, Gap Road, 3.9 km E Junction Bonang Highway, under *Acacia dealbata, A. melanoxylon, Eucalyptus fastigata* and *E. obliqua*, 27/5/1999, J.M. Trappe, H7597, C2593 (CANB). The Gap Scenic Reserve, Gap Road, 50 km E Bonang River Bridge, under *Acacia dealbata, A.melanoxylon, Eucalyptus dalrympleana* and *E. fastiiata*, 26/5/1999, A. Jumpponen, H7598, C2580 (CANB). **Western Australia**: Bebes Site, Northcliffe, under 1 year old *Eucalyptus globulus* plantation, pots inoculated with H1023, 8/9/1988, N. Malajczuk, H4317. CSIRO glasshouse, under *Eucalyptus globulus*, pots inoculated with H1023, 28/8/1987, N. Bougher, H1023, NB182.

DISCUSSION

The present study shows several examples of broad variation in basidiomal morphology expressed by taxa in the *Descolea-Setchelliogaster-Descomyces* complex. For example, some species such as *Descolea maculata* considered to be predominantly agaricoid also have sequestrate forms. In the transition from agaricoid to secotioid form, the hymenium becomes disorganised, gill anastomoses increase, and the stipe and annulus are reduced. The degree of basidiomal variation is strong in some species and less in others, e.g. *S. tenuipes* has agaricoid and secotioid basidiomata, but *S. australiensis* has only secotioid forms. For some species, variability in basidiomal form corresponds with changes in microscopic characters, e.g. decrease in abundance and extent of cheilocystidia with sequestrate basidiomata of *S. tenuipes*. In this case *S. rheophyllus* and *S. tenuipes*, formerly distinguished by presumed discontinuities in basidiomal form and cystidial occurrence, represent quantitatively variable character expressions by the same species. Other species in the *Descolea-Setchelliogaster-Descomyces* complex have variable basidiomal forms but little variation in microscopic characters, e.g. *Descolea maculata* and *D. gunnii*. Yet others have variable basidiomata and highly variable microscopic characters, e.g. an inconsistent relationship between basidiomal form and spores of *S. australiensis*.

Basidiomal variablity in the *Descolea-Setchelliogaster-Descomyces* complex can also occur within the same collection or be expressed by the same strain. For example, the isolate of *S. australiensis* from a natural forest in Tasmania inoculated into pot cultures and plantations in Western Australia has highly variable spore size and morphology (see Figure 33).

The question remains as to whether basidiomata are inherently variable in species of the *Descolea-Setchelliogaster-Descomyces* complex or determined by environmental influences. Environment is likely to have a lesser role, as we have observed many cases of broad variation among basidiomata of the same collection or isolates growing under uniform conditions. At present the absence of molecular differences between secotioid and agaricoid forms has been reported in *S. tenuipes* (Martín & Rocabruna, 1999)

This type of variability within species and genera is well known in other fungi, e.g. *Suillus* and *Gastrosuillus*, *Lactarius* and *Arcangiella*, *Russula* and *Macowanites*, *Cortinarius* and *Thaxterogaster* (Thiers, 1984), *Psilocybe* and *Weraroa* (Watling, 1971) and *Hydnangium, Podohydnangium* and *Laccaria* (Bougher *et al*., 1993). Broad variation in mature basidiomal morphology has been variously attributed to environmental factors (Chiu *et al*, 1989; Seo *et al*., 1995) and genetic factors (Kanda & Ishikawa, 1986; Takemaru & Kamada, 1972; Hibbett *et al*., 1994).

For many fungi classical taxonomy has used types of basidiomal morphology and spore release as main characters differentiating species and genera. However, recent molecular studies have revealed that the genetic boundaries between some well-differentiated morphological groups may not be as distinct as suggested by morphology, e.g. *Suillus* and *Gastrosuillus* (Baura *et al*., 1992; Kretzer & Bruns, 1997), and *Russula* and *Macowanites* (Martín *et al*., 1999). Similarly, reliance upon spore release type (heterotropic-ballistosporic versus orthotropic-statigmosporic) may not accurately determine boundaries between taxa, e.g. in some *Russulales* where a broad range from heterotropic ballistosporic to orthotropic putatively statismosporic spores has been found in the same basidioma (Miller & Miller, 1988). Spore discharge has an environmental component (Miller & Miller, 1988) and factors such as humidity and hymenial enclosure may be determining factors.

Basidiomal variability such as observed in some taxa suggests that the classical boundary between *Setchelliogaster* and *Descolea*, based on sequestrate *versus* agaricoid basidiomata, does not always separate the two genera. Some species of both genera have a natural spectrum of basidiomal morphology that crosses the boundary between the two genera. Agaricoid basidiomata of *Setchelliogaster tenuipes* could fit into genus *Descolea*, and sequestrate forms of *Descolea maculata* could be assigned to *Setchelliogaster*. In addition, it may not be accurate to distinguish the genera on the basis of spore symmetry. *Setchelliogaster australiensis* and *S. tenuipes* show broad variability in the spore shape from orthotropic to heterotropic.

Highly variable basidiomal morphology therefore has substantial implications for the definition of taxa in the *Descolea-Setchelliogaster-Descomyces* complex. The main implications include:

(a) Generic names defined by basidiomal form are categories useful in a broad practical sense but are not biologically distinct, as their boundaries are transgressed by some taxa, e.g. *D. maculata* has forms typical of *Descolea* and *Setchelliogaster*.

(b) Broader species concepts than currently recognised are necessary for some species, e.g. *S. tenuipes* encompasses forms formerly assigned to *S. rheophyllus*.

(c) Variability in macro- and microscopic characters emphasises the need to have multiple collections from many locations to accurately define taxa in *Descolea-Setchelliogaster-Descomyces* complex.

Broad variability in basidiomata within some species and individuals transgresses the formal concepts of the genera *Descolea* and *Setchelliogaster*. However variations expressed by taxa may be strong or weak and the extent of variation is probably not uniform across all taxa of the *Descolea-Setchelliogaster-Descomyces* complex. For the gastroid component of the *Descolea-Setchelliogaster-Descomyces* complex, there is currently no evidence of similar morphological variability in the genus *Descomyces*. Basidiomata are always gastroid without a distinct stipe and the spores are orthotropic (Bougher & Castellano, 1993).

ACKNOWLEDGEMENTS

Thanks to Dr. J. Trappe and Dr. A. Claridge for providing many collections of *Setchelliogaster tenuipes* and *S. australiensis*. Dr. J. Trappe and Dr. F. Calonge also provided critical feedback on draft manuscripts. This work was carried out during a research stay funded by Xunta de Galicia (Autonomic Spanish Government).

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MYCOTAXON

Volume LXXVIII, pp. 59-66 April-June 2001

NEW SPECIES OF COELOMYCETES FROM ARGENTINA

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ABSTRACT

Two new species of coelomycetes, *Microsphaeropsis diffisa* and *Placodiplodia hilata* are described and illustrated from twigs and rhytidomes of *Geoffroea decorticans* from Argentina.

Key words: Mitosporic fungi, *Geoffroea decorticans, Microsphaeropsis diffisa, Placodiplodia hilata.*

INTRODUCTION

During a survey of microscopic fungi associated with xerophytic plant species of Argentina, one species of *Placodiplodia* Bubák and other of *Microsphaeropsis* Höhn. were found growing on twigs and on the inner surface of rhytidomes of *Geoffroea decorticans* (Fabaceae). Neither of the two collections proved assignable to a current known species, so they are accordingly described and illustrated here.

MATERIAL AND METHODS

Free-hand thin sections of conidiomata were prepared for microscopic studies. For observations and measurements 3% KOH or water were used as mounting media. For describing conidiogenesis the terminology proposed by Hennebert and Sutton (1994) was used. Specimens are lodged at BBB (Bahía Blanca Biología) Herbarium.

Microsphaeropsis diffissa Bianchin., sp. nov.

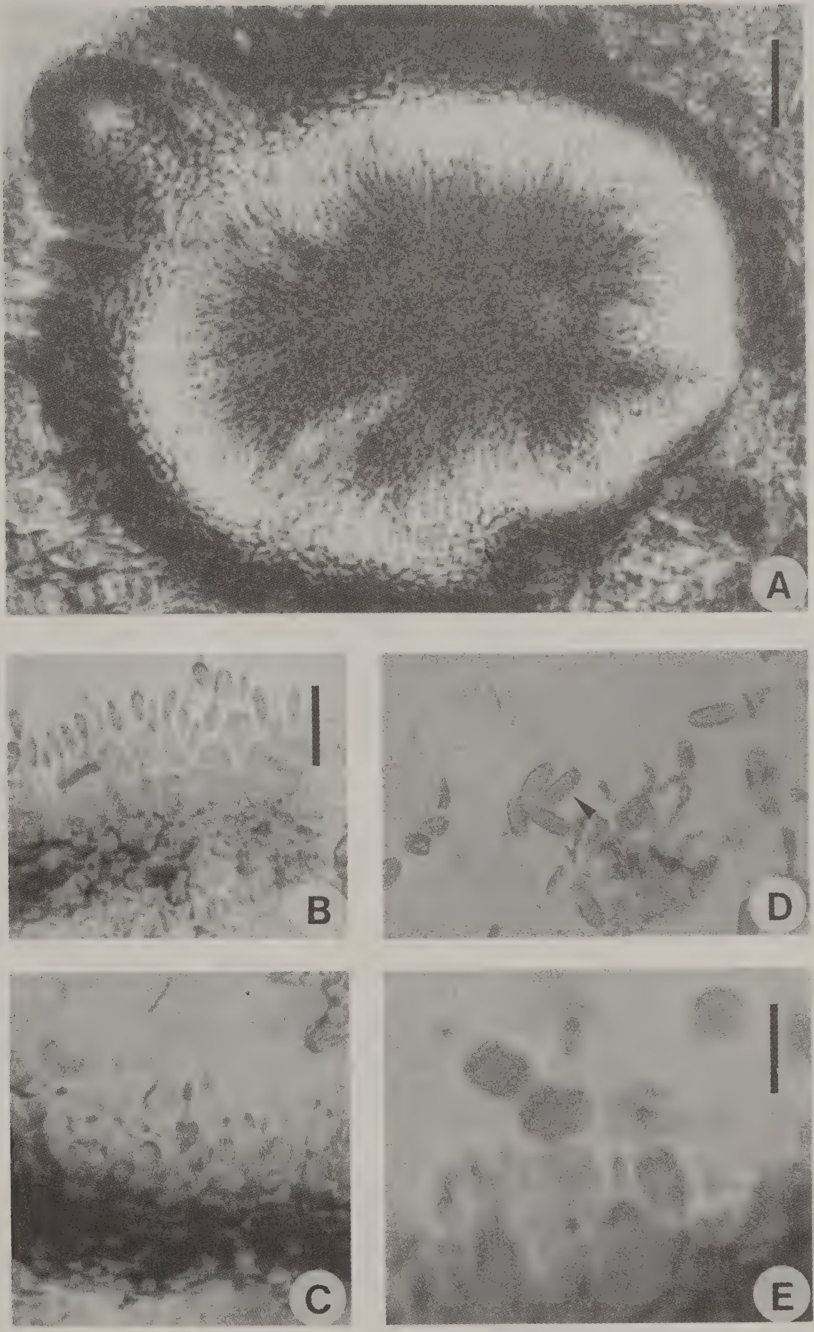
Etymology: from Latin *diffindo* (fissure), referring to the longitudinal raphe present on the conidia.

Conidiomata pycnidialia, brunnea, immersa vel errumpentia, globosa, unilocularia, ca. 150 µm diam. Parietes crassi 4-6 cellulis ex textura angulari. Ostiolum papillatum. Conidiophora hyalina, septata, non ramosa. Cellulae conidiogenae discretae vel integratae, hyalinae, laeves, ampulliformes vel cylindricae, 3-6,5 x 2-3 µm. Conidia blastica, enterogena, pallide ferruginea, aseptata, elliptica vel irregularia, laevia, sparse guttulata, raphe longitudinali, 3,5-5(-6) x 1,5-2 µm. In cortice Geoffroeae decorticantis (Hook. & Arn) Burk. Argentina. Typus BBB 150.

Mycelium dark brown, immersed, ramified, septate. *Conidiomata* pycnidial, globose, immersed to errumpent, scattered to gregarious, unilocular, dark brown, ca. 150 µm diam., wall formed by 4-6 cell layers of *textura angularis*. Ostiole single, central, circular, papillate. *Conidiophores* hyaline, septated, unbranched. *Conidiogenous cells* hyaline, discrete or integrated, globose, doliiform to cylindrical, determinate, loci apical, or lateral below septa, channel and periclinal wall thickening prominent, 3-6.5 x 2-3 µm. *Conidia* blastic, enterogenous, aseptate, thin-walled, irregularly guttulate, ellipsoidal, straight or slightly curved, apex and base obtuse, smooth, with a longitudinal raphe, in mass pale rusty, individually subhyaline to pale brown, 3.5-5(-6) x 1.5-2 µm. *Teleomorph* not known.

Specimens examined: Argentina. Prov. Buenos Aires: Pdo. Cnel. Rosales, Arroyo Parejas, rhytidome of *Geoffroea decorticans* (Fabaceae), April 1987, Bianchinotti 151 (BBB) (holotype). Prov. Buenos Aires, Pdo. Bahía Blanca, Campo Tarantino, twigs of *G. decorticans*, April 1986, Bianchinotti 150 (BBB).

Fig. 1. *Microsphaeropsis diffisa*. A- Pycnidial conidioma in cross section. B- Conidiogenous cells. C- Peridium. D- Aseptate conidia with longitudinal raphe (arrow). E- Details of integrated conidiogenous cells.
Bars: A= 20 µm, B-D= 10 µm, E= 5 µm.


A
B
C
D
E

Discussion: This collection was identified as a species of *Microsphaeropsis* as it has pycnidial conidiomata, conidiogenous cells with determinate loci and blastic, enterogenous, aseptate, brown conidia (Sutton 1980). Morphological features of *M. diffissa* do not match with any of the described species of *Microsphaeropsis* (Morgan-Jones, 1974; Sutton 1971, 1974, 1980). This new species can be easily differentiated from the other species of the genus with smooth conidia by having terminal and lateral conidiogenous cells and minute conidia with a longitudinal raphe.

Microsphaeropsis concentrica (Desm.) Morgan-Jones has previously been recorded on the same host (Bianchinotti, 1998), but this species possesses larger, spherical, rough-walled conidia (Morgan-Jones & White, 1987).

Other species of *Microsphaeropsis* recorded from Argentina are *M. callista* (Syd.) B. Sutton from living leaves of *Eucalyptus viminalis* Labill. (Cabral, 1982), *M. olivacea* (Bonord.) Höhn. from living leaves of *Pinus tadea* L. and *M. pseudaspera* B.Sutton from bark of *E. viminalis* (Romero, 1998).

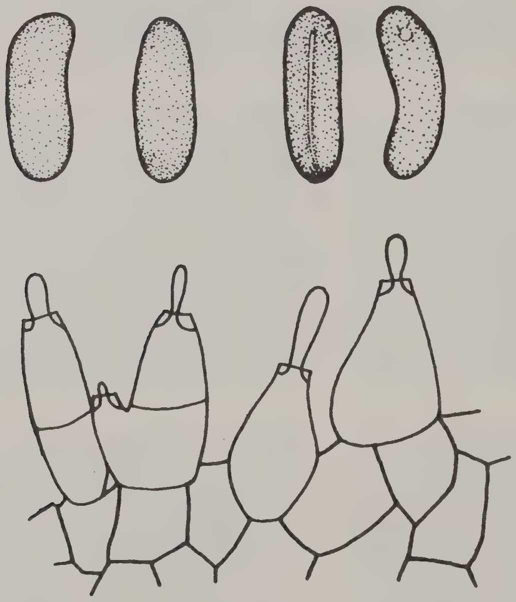


Fig. 2. *Microsphaeropsis diffisa*. Conidia and conidiogenous cells. Bar= 5 µm.

Placodiplodia hilata Bianchin., sp. nov.
Etymology: from the Latin *hilum*, denoting this prominent feature on conidia.

Conidiomata stromatica, pycnidialia, sparsa vel gregaria, interdum linearia confluentia, innato-errumpentia, brunnea vel nigra, ambitu ellipsoideo vel irregulari, in sectione transversali lattissime ovata vel globosa applanata, loculo simplici, glabra, per rimam lineari in pariete apicali dehiscentia, 100-180(-200) µm lata x (35-)50-75(-85) µm diam. Parietes 3-4 cellulis crassis ex textura angulari, tenuitunicatis et hyalinis in basibus. Conidiophora ad cellulas conidiogenas contracta. Cellulae conidiogenae ampulliformes, hyalinae vel pallide olivaceae, laeves, determinatae vel percurrentes, cum dilute annellationibus apicalibus, bases 5-6 µm diam., longitudine varia. Conidia blastica, enterogena, perpallide aeruginosa vel pallide brunnea, late ellipsoidea, utrinque obtusa, bases cum hilo magne protruso, recta vel curvata, bifariam irregulariter compressa, laevia, tenuitunicata, uniseptata, euseptata, ad septa haud vel profunde constricta, (7-)8,5-10,5(-11) x 4,5-5,5 µm. In ramiis Geoffroeae decorticantis. Typus BBB 152.

Conidiomata stromatic, pycnidial, scattered to gregarious, sometimes linearly confluent, immersed-erumpent, dark brown to black, navicular to irregular in outline, subglobose to depressed ovate in transverse section, unilocular, true ostiole absent, dehiscence by a longitudinal fissure of the upper wall, 100-180(-200) µm long x (35-) 50-75(-85) µm diam. Peridium comprising a stratum of 3-4 layers of thick-walled, brown *textura angularis*, becaming paler and thinner-walled basally. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* peripheral, discrete, hyaline to very pale olivaceous, broadly ampulliform, determinate, holoblastic or indeterminate with monopodial, enterogenous, percurrent proliferation producing inconspicuous annellations, neck 2-5 µm diam., base 4-6 µm diam., up to 12 µm long. *Conidia* blastic, enterogenous, solitary, broadly ellipsoidal, with obtuse ends, straight to slightly curved, irregularly compressed, base with a protuberant centric or somewhat eccentric hilum, thin-walled, smooth, gray to pale brown, 1-euseptate, not to strongly constricted at the septum, (7-)8.5-10.5(-11) x 4.5-5.5 µm. *Teleomorph* not known.

Specimens examined: Argentina, prov. Buenos Aires: Pdo. Bahía Blanca, Campo Tarantino, April 1986, twigs of *Geoffroea decorticans* (Fabaceae), M.V. Bianchinotti 152 (holotype) (BBB); ibid., Dec.1987, Bianchinotti 51, 153, 154 (BBB).

Discussion. This collection was identified as *Placodiplodia* Bubák as it has navicular, linearly confluent, longitudinally fissured conidiomata, blastic conidiogenous cells and pale, 1-euseptate conidia (Sutton, 1980). Although conidiogenous cells have been described as determinate, Sutton (1980) acknowledges that the holotype was too old for elucidate full details of conidiogenesis and that only one "phialide" was found.

Zambettakis (1955a) lists 11 species in this genus that except for two, *P. copelandii* Bubák and *P. parinarii* Zambett., all were tranfers from existing genera. From these, *P. yuccae* (Speg.) Zambett. (bas. *Diplodia juccae* Speg.) has plurilocular conidiomata with larger conidia (20-25 x 10-13 µm, *fide* Zambettakis, 1955b) and *P. agropyri* (Speg.) Zambett. (bas. *Paradiplodia agropyri* Speg.) is considered an error by Farr (1973), perhaps referable to *Paradiplodia agropyri* (Murashk.) Lavrov, the type species of *Dothideodiplodia* Murashk., a genus with plurilocular conidiomata originating from an immersed hypostroma.

With the exception of *P. copelandii*, none of the other species accepted by Zambettakis has been recently revised, but according to the most recent interpretation by Sutton (1977, 1980), they should be relocated to other genera.

Placodiplodia hilata can be distinguished from the type species by having coloured, larger conidiogenous cells and shorter, wider conidia with distinct hila (12-15 x 4 µm in *P. copelandii*, *fide* Zambettakis, 1955b).

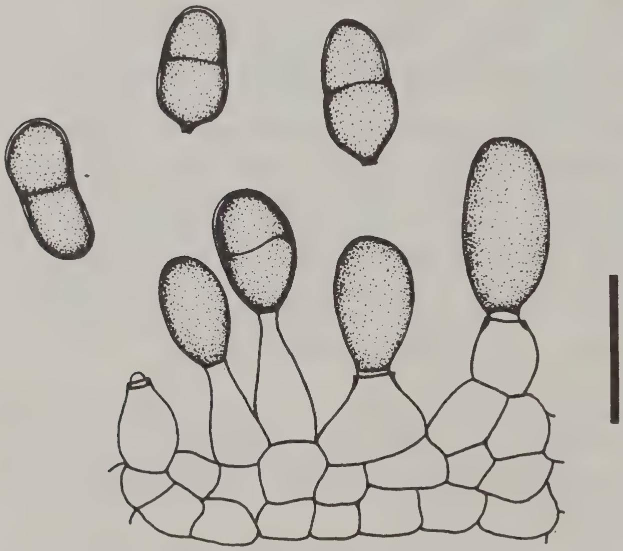


Fig. 3. *Placodiplodia hilata*. Conidia and conidiogenous cells. Bar= 10 µm.

Of the many genera which have pycnidial conidiomata and percurrently proliferating conidiogenous cells, this specimen was also compared with *Macrohilum* H. J. Swart, a genus proposed by Swart in 1988 to accomodate a single species, *M. eucalypti* H. J. Swart, found growing immersed in dead mesophyll tissues of *Eucalyptus polyanthemus* Schauer. leaves. It differs from *P. hilata* as the conidiomata are single, thin-walled, globose with a fairly wide ostiole, conidiogenous cells are described as holoblastic with flared annellations and although conidia possess a large hilum, they are differently shaped (Swart, 1988).

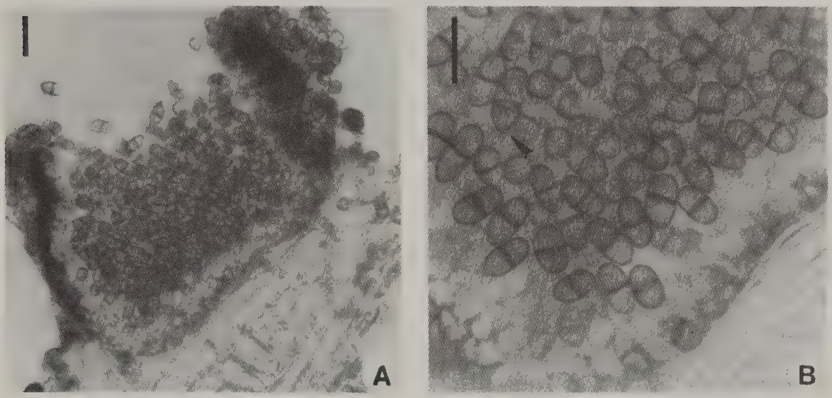


Fig. 4. *Placodiplodia hilata.* A- Conidioma in cross section. B- One-septate conidia with protuberant hila (arrow).
Bars: A= 20µm, B= 10µm.

ACKNOWLEDGEMENTS

Financial support from CONICET (Consejo Nacional de Investigaciones de Argentina) and UNS (Universidad Nacional del Sur) is acknowledged.
Dr. Pedro Crous (Plant Pathology, U. S., South Africa) is warmly thanked for acting as presubmission reviewer and for his valuable comments on the MS.
Lic. Marta Garelli (Dept. Humanidades, UNS) is also thanked for correcting the Latin translations.

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MYCOTAXON

Volume LXXVIII, pp. 67-74 April-June 2001

NOTES ON THE BAMBUSICOLOUS SPECIES OF THE GENUS HYPOCRELLA FROM SOUTHWESTERN CHINA

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ABSTRACT

Two bambusicolous species of the genus *Hypocrella* are reported and described from southwestern China. One of them is identified as a new species, namely *Hypocrella tenuispora*. Its diagnosis and illustrations are given and differences from other similar species are discussed. Another species, *H. bambusae*, is re-described in detail based upon Chinese collections. Both species are endemic in southeastern Asia.

KEY WORDS *Hypocrella tenuispora*, new species, *H. bambusae*

The genus *Hypocrella* Sacc. (Clavicipitales, Ascomycota) is one of the more easily recognized ascomycete genera because of its brightly colored stromata. The genus was established by Saccardo in 1878 and placed in the family Hypocreaceae (Saccardo, 1883). It is more reasonable for the genus to be in the family Clavicipitaceae according to their filiform ascospores (Hywel-Jones and Evans, 1993; Hawksworth et al., 1995; Rossman et al., 1999). Petch (1921) and Mains (1959) reviewed the genus and confirmed that species of *Hypocrella* are entomogenous. The species occur specifically on immature stages of scale insects belonging to two families of Homoptera (Aleyrodae & Coccidae) (Hywel-Jones and Samuels, 1998). Up to now, more than 30 species have been recorded; among them five species are on scale insects on bamboo, and many species are primarily tropical or subtropical in distribution (Petch, 1921, 1925; Mains, 1959; Hywel-Jones and Evans, 1993; Hywel-Jones, 1995; Hywel-Jones and Samuels, 1998; Ying and Zang, 1994). Most of them are perfect states of species of the genus *Aschersonia* Mont. (mitosporic fungi) (Thaxter, 1914; Petch, 1921, 1925; Mains, 1959; Dennis, 1970;

Hywel-Jones and Evans, 1993; Hywel-Jones, 1995; Hywel-Jones and Samuels, 1998; Hawksworth et al., 1995).

Some bambusicolous collections of the genus *Hypocrella* were collected from southwestern China recently and deposited in the Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica (abbreviated HKAS henceforth). They were identified as two different species. Only one species, *H. bambusae* (Berk. et Br.) Sacc., was previously known from SW China and described based on quite limited material (Ying and Zang, 1994). Although external and anatomical characters are quite similar to Saccardo's short description (Saccardo, 1883), there are some differences in the Chinese collections. Furthermore it differs greatly from Petch's description (Petch, 1921). His diagnosis is somewhat doubtful in the macro- and microscopic characters of the species. The holotype had never been cited and has not yet been found. So it is necessary to re-describe on the species in detail. Examination of another specimen showed it to be distinct from *H. bambusae* or other known species. It is described here as a new species in the genus. As yet unfortunately their imperfect states have not been observed, no anamorph of either is known from China, and no connection to scale insects is evident.

Hypocrella bambusae (Berk. et Br.) Sacc.

Michelia 1: 323, 1878; Syll. Fung. 2: 580, 1883.

Basionym: *Hypocrea bambusae* Berk. et Br., Fung. Ceyl. N. 999; Jour. Linn. Soc. 14, 113, 1847.

Balansia bambusae (Berk. et Br.) Petch, Ann. Perad., 6, 170, 1916.

Fig. I: 1-7

Stromata placentiform, hemispherical or sub-globose; pinkish red or brownish red to red colour, becoming yellowish brown, reddish brown or testaceous; hard and pseudocarbonaceous in dried condition; 1.0-1.5 cm diameter, 0.7-1.3 cm high; with irregular papilliform projections on the upper surface, and with subclose-set, papilliferous ostioles projecting up to 0.3-0.5 mm. Stromata concave below, broadly attached, internally with a dark red to dark blood red layer (0.2-0.5 mm thick) around the periphery of the upper portion of the ascomata; some blue pigment releasing from them in 5% KOH and rufous with more red pigment escaping in lactophenol. Surface tissue of stromata separated into three

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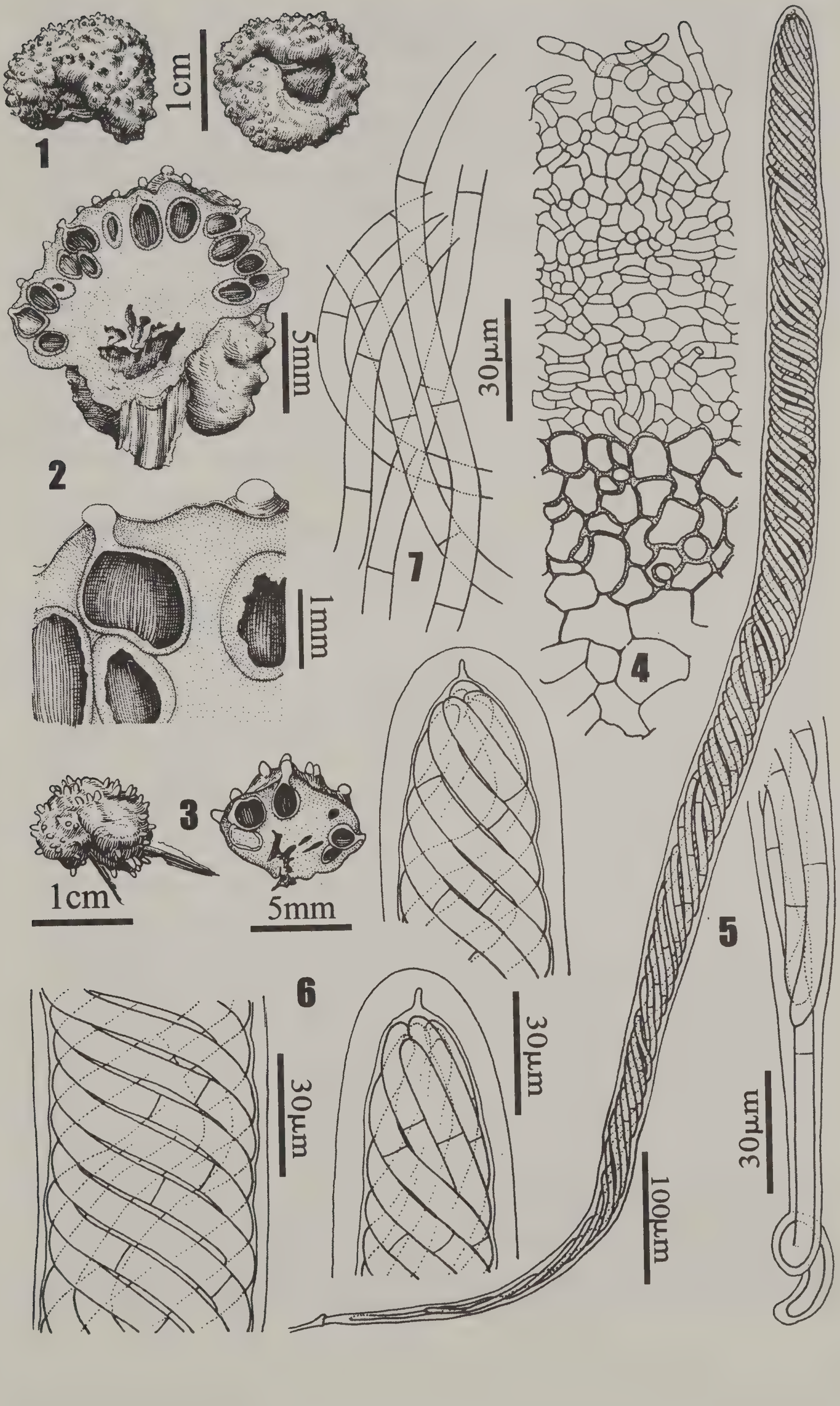
Fig. I. *Hypocrella bambusae*. 1. Stromata (lateral and basal views). 2. A vertical section. 3. Stroma & a vertical section. 4. Vertical section of the surface of stroma. 5. An ascus & a base of an ascus. 6. Apices of asci and a middle part of ascus. 7. Multiseptate ascospores. (Figs. 1, 2, 4, 5, 6, 7, from the specimen HKAS 4594; 3, from the specimen HKAS 14546).


1
1cm
2
5mm
1mm
3
1cm
5mm
7
30µm
4
5
6
30µm
30µm
100µm
30µm

layers. The upper layer up to 98.8 μm thick and composed of thin-walled hyphae (2.6-6.5 μm in diameter). The middle layer 45.5 μm thick, consisting of slightly thick-walled and pigmental hyphae (5.2-13.0 μm in diameter). The lower layer with larger diameter (up to 9.1-18.2 μm in diameter) thin-walled hyphae. Perithecia flask-shaped, mostly dacryoid or subglobose, occasionally broad wedge-shaped, subregularly arranged in the periphery of the upper portion and completely immersed in the stroma, 1.4-2.4 mm in vertical diameter, 0.9-1.7 mm in transverse diameter. Paraphyses not observed. Asci arising from a basal cluster, up to 1200 μm long, or even almost as long as the vertical diameter of the perithecia, (27.8-) 44.0-55.4 μm thick, mostly 8-spored, spores arranged in a helix and twisted into a rope-like group. Ascostome not seen, but with a smaller and clear furrow or axial canal in the apex of the ascus and without a distinct cap. Ascospores filiform, hyaline, almost as long as asci, multiseptate, each cell 26.4-54.5 × 6.2-8.1 μm, not disarticulating into part-spores in the ascus. Pycnidia not occurring.

Habitat: At the base of leaf sheaths on small branch apices of living bamboo, *Fargesia* aff. *melanostachys* (Hand.-Mazz.) T. P. Yi [=*Sinarundinaria* aff. *melanostachys* (Hand-Mazz.) Keng f.] in alpine and sub-alpine bamboo forests.

Specimens examined: **Yunnan:** Li Zu-Qiang 981 (HKAS 34357), Jun. 6th, 1997, alt. 3000 m, Lijiang County. Wan Xiang-Yi, no number (HKAS 4594), Jul. 1977, alt. 3200 m, Judian, Lijiang County. Wan Xiang-Yi, no number (HKAS 4571), Jun. 6th, 1979, alt. 3800 m, same locality as above. Zang Mu 4400 (HKAS 4400), Jul. 1978, alt. 3200m, Yulong Snow Mts., Lijiang County. Wan Xiang-Yi (HKAS 3691), Jul. 1977, same locality as above. Wang Li-Song 16 (HKAS 9712), May 24, 1982, alt. 3500 m, Lu-Ma-Deng Mts. Fork, Weixi County. Xi Jian-Xun 109 (HKAS 9682), May 21, 1982, alt. 3150 m, Weideng to Haizi, Weixi County. Xuan Yu, no number (HKAS 11744), 1983, Lijiang County. Li Xing-Jiang 975 (HKAS 7905), Jun. 16th, 1981, alt. 3480m, Hongshan forestry farm, in *Picea* forestry, Xiaozhongdian, Zhongdian County. Su Yong-Ge 1 (HKAS 14546), Jul. 1st. 1984, alt. 2600 m, Dian-cang Mts., Yangbi County.

Known distribution. South Asia (Sri Lanka and Yunnan, China).

Notes: Saccardo (1883) provided a short Latin description as follows: "Placentiformis, fusca, granulata; Asci linearibus apice capitellatis; sporidiis filiformibus. Hab. In inflorescentis Bambusae in Ceylon." Unfortunately there are no size records of stromata and spores in the description. Chinese specimens are similar to this description in macro-characteristics except for stromata not occurring in inflorescences of bamboo. Petch's (1921) description differs in stromata too small (only 1.5 mm diameter), spores quite narrow (merely 1-1.5 μm), etc. No specimens were cited in his publication. He came to a conclusion from the structure of the stroma, that this species is evidently a *Balansia*. He described it as *Balansia bambusae* (Berk. et Br.) Petch. The conclusion is inadequate or might be a mistaken identification. The holotype of this species was from Ceylon

(Sri Lanka) and had not been reported again from South Asia since Saccardo (1883). The diameter and morphology of the ascospores of the Chinese specimens are clearly different from the description made by Petch (1921). As to the asci, these are always 8-spored at the middle of asci without exception. But sometimes they appear 4-, 5-, or 6-, mostly 4-spored at the apex of asci, rarely 8-spored, as there are 4 or 5-7 precocious ascospores in the ascus apex. Similarly, there are 3 or 2, mostly 4 ascospores in the lower part of the mature ascus. In the specimens examined here, the widest part of the ascus is in the middle, where all 8 ascospores overlap. Such conditions are more or less like those of *H. discoidea* (Hywel-Jones and Evans, 1993). In regard to partspores, there is no evidence of fragmentation of ascospores, breaking into partspores (Ying and Zang, 1994), just as mentioned in the species *H. discoidea* (Hywel-Jones and Evans, 1993) or other species (Mains, 1959). Although Saccardo's description was not sufficiently detailed, the species name has been accepted here for Chinese specimens based on the macro- and micro-characteristics (Saccardo, 1883).

No culture isolations were attempted from these materials.

According to the temporal distribution patterns, it appears to be a South Asian endemic species.

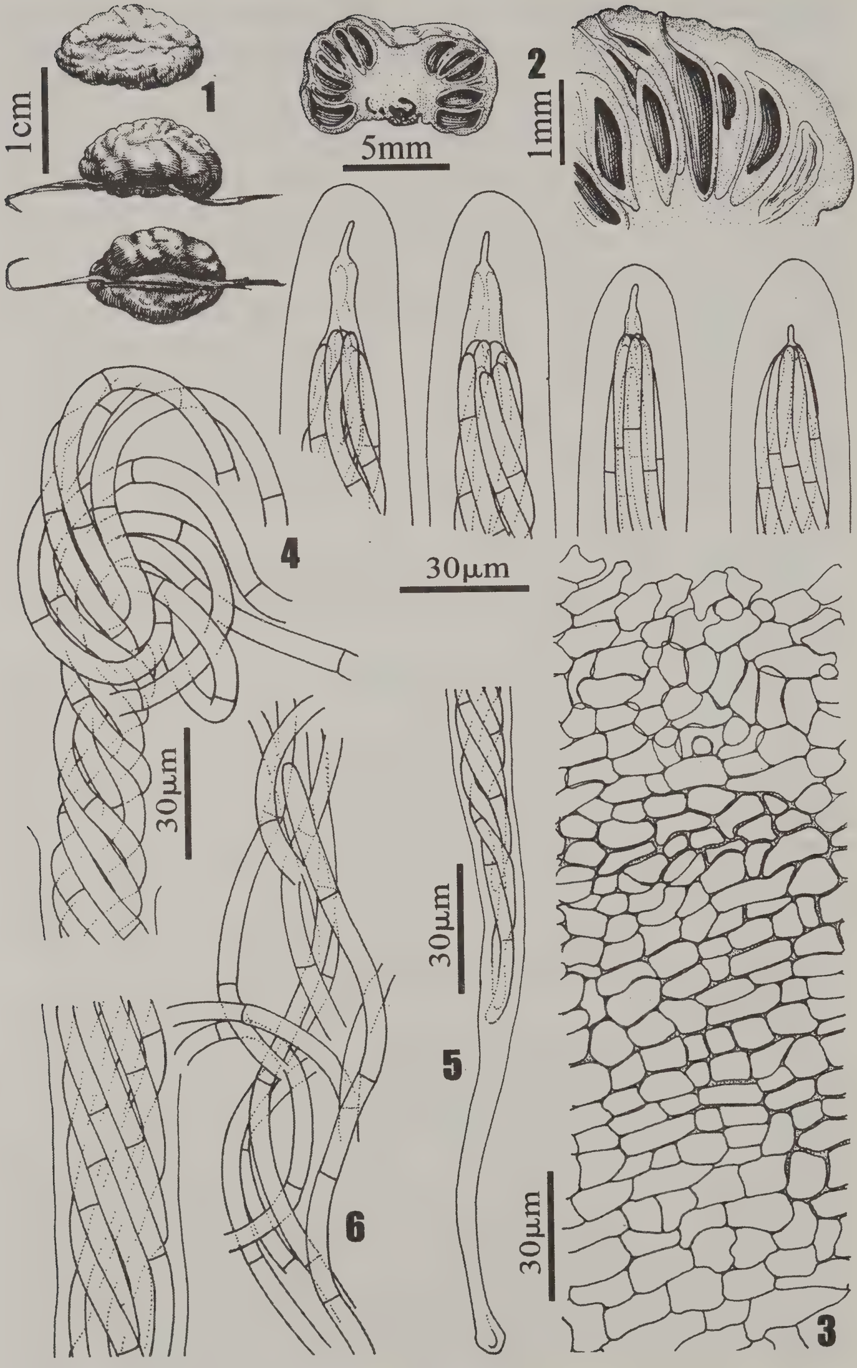
Hypocrella tenuispora P. G. Liu et Z. Q. Li sp. nov.

Fig. II:1-6

Stramata lata ellopticae, scutetae vel pulvinatae; utroque gradatim angustatae obtusae; nigricans vel anthracinae; carnosae; 0.6-1.5 cm longae, 0.5-0.9 cm latae, 0.4-0.6 cm altae; suberficiebus plus minusve convecis et concavis, levigatis vel leviter asperibus, area centralis depresso et sterili. Perithecia ampuliformia, anguste oblonga, vulgo fusiformia vel ellipticofusiformia, 1.75-2.67 × 0.5-1.1 mm. Asci clavati, magni, octospori, spirales, 1650-2360 μm longi, 25.6-30.6 μm diam.. Ascosporae admodum longae, filiformesin in cochleam torta, multiseptatae, segmentis omnia 22.5-45.0 × 3.7-5.6 μm, non separatae in part-sporas.

Habitat in Fargesis affinis fungosa T. P. Yi. Subalpinis. Holotypus HKAS 34359.

Stromata elongated ellipsoid, scutate or pulvinate, up to 0.6-1.5 × 0.5-0.9 cm, 0.4-0.6 cm thick; towards both ends of stromata gradually narrowing but obtuse; dark chestnut brown, becoming dark brownish black when dry; base sterile, broadly attached, fleshy when fresh but quite hard and pseudocarbonaceous when dry. Surface of stromata usually even and rough or smooth in young specimens, becoming convex-concave or tuberculate by protrusion of ostioles of perithecia in aged stage; minutely umbilicate and sterile in the center of stroma. Outmost layer 0.05-0.1 mm thick; internally with a dark red layer about 0.1-0.3 mm thick towards the exterior in old specimens. Blue pigment releasing in 5% KOH, some red, close to rufous, pigment escaping in lactophenol. Hyphal tissue of the


1cm
1
5mm
2
1mm
4
30µm
30µm
30µm
5
6
30µm
3

surface of stroma separated into three layers. Upper layer about 75μm thick and composed of thin-walled and irregular hyphae (8.2-18.8 × 6.8-8.2 μm). Middle layer up to 110 μm thick, with slightly thick-walled and pigmented hyphae (7.5-21.3 × 4.4-7.5 μm). Internal layer consists of thin-walled hyphae (7.3-24.4 × 5.3-10.5 μm). Perithecia immersed and scattered just below surface of stroma, usually arranged regularly around the periphery except at the center of stroma, narrow flask-shaped to oblong, mostly fusiform or elliptic-fusiform, the ostiole almost not projecting above the surface, perithecial neck 1.75-2.67 mm long, 0.5-1.1 mm diameter. Asci quite long, up to 1,650-2,360 μm long, 25.6-30.6 μm in diameter, eight-spored always in the middle of ascus, sometimes 4 precocious ascospores in the ascus apex, similarly, always 2-4 ascospores in the foot of the mature ascus. Ascospores filiform, hyaline, arranged spirally and twisted into a rope-like group, multi-transverse-septate, but not disarticulating into partspores within the asci, each cell 22.5-45.0 × 3.7-5.6 μm. Pycnidia not seen.

Anamorph. None known.

Habitat: In the base of leaf sheath on the small branch tops of living bamboo, *Fargesia* aff. *fungosa* T.P.Yi in sub-alpine bamboo forests.

Etymology: from Latin, tenui-= slender & narrow, spora = spore, referring to the slender ascospores than those of *H. bambusae*.

Specimens examined: Li Zu-Qiang et al. 993 (HKAS 34359, Holotype!), Aug. 1997, altitude: 1800-2300m, a place 36 km from south of Yiliang County, Zhao-tong, Yunnan, SW China. Li Zu-Qiang et al. 982 (HKAS 34358, Paratype!), Jun. 26, 1997, alt. 2300m, near to Xiaocaoba tree farm, Yiliang County, Yunnan, SW China.

Known distribution. Known only from the type specimens.

Notes: The macro- and especially microscopic characters of the species indicates a relationship to the species *H. bambusae* (Saccardo, 1883) from Yunnan, China (Ying and Zang, 1994). However this species is well distinguished by the outside shape, almost smooth surface, different color of stromata and much slenderer ascospores, as well as by different chemical compounds (another paper will report on this).

Ecological observation: Most species of the genus are parasitic on or attacked by scale insects, Coccidae and white flies, and as a consequence some prominent cavities should be presented inside of stromata (Mains, 1959; Hywel-Jones et al., 1993). Some small cavities can be found inside stromata, but without any traces of insect activities in the Chinese

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Fig. II. *Hypocrella tenuispora* nov. sp. (HKAS 34359). 1. Stromata (upper, lateral and basal views). 2. Vertical sections of stromata. 3. Vertical section of the hyphal tissue of the surface of a stroma. 4. The upper parts and apices of asci (upper right) as well as middle parts of ascus (lower left). 5. A base of an ascus. 6. Multiseptate ascospores.

specimens. Such special ecological relationships should be studied more and carefully in the field or in fresh condition.

ACKNOWLEDGEMENTS

The project was supported by the Natural Sciences Foundation of Yunnan, China (97C083M), the special fund for Taxonomy & Flora of the Chinese Academy of Sciences (No.9926) and the National Natural Scientific Foundation. Sincere appreciation is due to Prof. R.P. Korf of the Plant Pathology Herbarium, Cornell University, New York and Dr. A.Y. Rossman of the Systematic Botany and Mycology Laboratory, USDA, Agricultural Research Services, Beltsville, U.S.A. for their helpful suggestions and critical review of the manuscript. Ms. Holly L. Chamberlain of the Department of Plant Pathology, Pennsylvania State University kindly provided valuable publications. Gratefully acknowledge Dr. De-Zhu Li, Kunming Institute of Botany, Chinese Academy of Sciences, for identifying the species of the hosts.

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汉文摘要

本文报道了中国西南产两种竹生亚肉座菌，其中一种为新种，即细孢亚肉座菌 *Hypocrella tenuispora* nov. sp.，就其相近种和相似种进行了讨论，子实体黑褐色、肾形、子囊孢子纤细为本种主要鉴别特征。另一种为竹生亚肉座菌 *Hypocrella bambusae* (Berk. et Br.) Sacc.，基于中国的标本对该种重新作了详细描述。两者均为东南亚特有种。

MYCOTAXON

Volume LXXVIII, pp. 75-103 April-June 2001

FOLIICOLOUS AND CAULICOLOUS FUNGI ASSOCIATED WITH PROTEACEAE CULTIVATED IN CALIFORNIA

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ABSTRACT

Proteaceae, cultivated in California for the cut-flower industry, were assessed for the occurrence of leaf and stem pathogens. Although fields and nurseries were relatively disease free, several unrecorded pathogens were collected. The most important of these are *Coleroa senniana, Botryosphaeria dothidea* and *Elsinoë leucospermi*, which can cause significant losses for producers in California, and also *Batcheloromyces leucospermi, Botryosphaeria proteae* and *Coniothyrium leucospermi,* which are generally regarded to be of lesser economic importance. New species described include *Camarosporium* sp., *Coniothyrium septatum*, *Elsinoë fecunda*, *Mycosphaerella leucospermi, Mycosphaerella* sp. and *Stigmina californiae*. *Didymosphaeria futilis* was recorded for the first time associated with proteaceous hosts. A compilation of all fungi recorded on proteas cultivated for the cut-flower industry in the U.S.A. (excluding Hawaii) is given. It is suggested that further collections of pathogens should be made at different times of the year, to obtain an overall impression of the status of proteaceous diseases in California.

KEY WORDS: Fungal pathogens, phytosanitary, systematics.

INTRODUCTION

In the U.S.A., *Proteaceae* (proteas) are cultivated only in two states, California and Hawaii. The climate and soils in these regions are suitable for this crop and there is a growing market in the U.S.A. and abroad for these products (Perry 1998). There are no indigenous *Proteaceae* in the U.S.A., as *Proteaceae* is a southern hemisphere plant family, restricted to Asia, Australasia, southern Africa and Central and South America (Rebelo 1995). This has advantages and disadvantages for the protea cut-flower industry in the U.S.A. The disadvantages are that the acquisition of new genetic material for the development of novel cultivars is restricted. Most new cultivars of proteas are derived from South Africa and Australia (Middelmann 1998). However, the advantages are that the plantations are relatively disease free (Perry 1998), unlike their South African counterparts, and that providing phytosanitary practices are thorough, they should remain that way.

Proteas form an important component of the cut-flower industry in California (Middelmann 1998). Until the present study, however, there had been no scientific and systematic sampling of protea diseases in the U.S.A. Thus, the aim of this study was to carry out a scientific survey of the diseases associated with proteas cultivated in California. These data are combined with that of previous records from the U.S.A. An overall impression of the status of plantations in California is given and the most important findings are discussed.

METHODS AND MATERIALS

Symptomatic leaf and stem samples of cultivated proteaceous hosts (*Grevillea* R. Br. ex Knight, *Leucospermum* R. Br., *Leucadendron* R. Br. and *Protea* L.) were collected and surveyed for the presence of fungal fruiting structures. Microscopic examination was carried out on material mounted in water and lactophenol, respectively, and measurements made at x1000 magnification. In cases where measurements were made from mounts in lactophenol, this is stated. The 95% confidence intervals were determined from 30 observations and the minimum and maximum ranges given in parentheses. Herbarium specimens are lodged at PREM and HKU(M), and reference cultures are maintained in the culture collection of the Department of Plant Pathology, University of Stellenbosch (STE-U). However, facilities were not available for making isolations for the majority of the specimens at the time of collection, and specimens were treated by quarantine officers to kill all fungi and insects present.

TAXONOMY

Camarosporium **sp.**

Figs. 1–11

Leaf spots circular to irregular, necrotic, sunken, grey-brown with a raised dark brown margin, up to 25 mm diam. Conidiomata amphigenous, pycnidial, nonerumpent but raising host surface slightly, dark brown, 90–170 µm diam. (Fig. 1); in section, substomatal, subepidermal, globose with a central, non-papillate ostiole, reduced stroma consisting of brown fungal hyphae in hosts cells surrounding ostiole, conidiogenous cells peripheral, approximately 270–300 µm high × 250–300 µm diam. (Fig. 2). Peridium comprising an outer stratum of thick-walled, small-celled, pale brown textura angularis becoming thin-walled inwardly; with the innermost cells thin-walled and hyaline, 20–25(–45) µm diam. (Fig. 2). Conidiophores reduced to conidiogenous cells. Conidiogenous cells subglobose, hyaline, determinate to indeterminate, 6–9 × 5–8 µm; conidiogenesis holoblastic, with infrequent percurrent proliferation, producing up to three wide annellations (Figs. 3 and 4). Conidia red-brown, muriform, with transverse, longitudinal and oblique eusepta, oblong, ellipsoidal to globose, base truncate apex obtuse, thick-walled, verruculose, (9–)12–14(–17) × (6–)7.5–8(–10) µm (Figs. 5, 7 and 8). Germination of the conidium was by the development of a single germ tube, produced from the basal cell of the conidium (Fig. 6). *In vitro*: Conidiogenous cells, pyriform to globose, hyaline, 7–12 × 7–9 µm (Figs. 9 and 10). Conidia initially hyaline, becoming medium red-brown with maturity, 0–1(–3) septate, thinner-walled, smooth, 7–12 × 7–9 µm (Fig. 11).

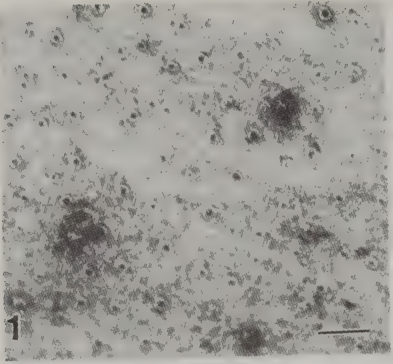
CULTURAL CHARACTERISTICS: On 2% malt extract agar (MEA; Biolab, Midrand, South Africa), supplemented with 0.1g/L Streptomycin sulphate at 25°C in the dark, colonies circular with undulate margins, buff (19"d) (Rayner 1970), often with darker patches visible. In reverse, brown vinaceous (84"'m), with broad concentric bands of buff (19"d) and brown vinaceous (84"'m). Moderately dense, felty to woolly aerial mycelium. Colonies reaching 60 mm diam. after 20 days.

SPECIMENS EXAMINED: U.S.A.: California, Santa Barbara, leaf spot on *Protea cynaroides* (L.) L., 8 Apr. 1998, L. Swart (JT 396, PREM 56474, STE-U 3040); California, Santa Barbara, leaf spot on *Leucospermum cordifolium* (Salisb. ex Knight) Fourc., 8 Apr. 1998, L. Swart (JT 469, PREM 56473).

TELEOMORPH: Unknown.

HOST RANGE: *Protea cynaroides* and *Leucospermum cordifolium*.

GEOGRAPHIC DISTRIBUTION: U.S.A. (California).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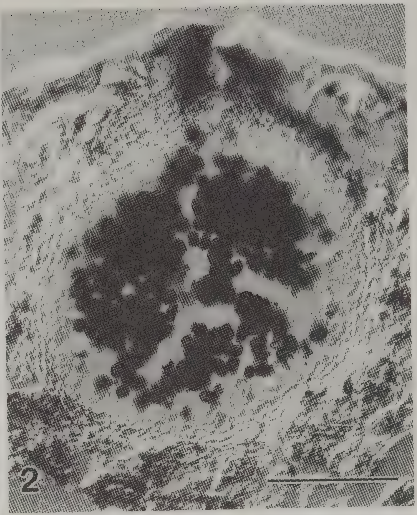
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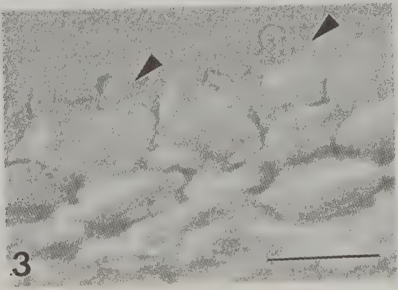
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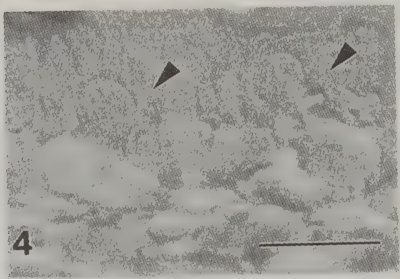
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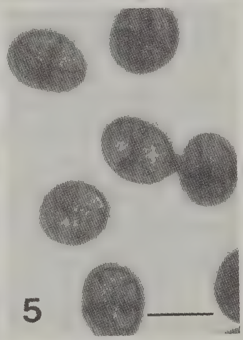
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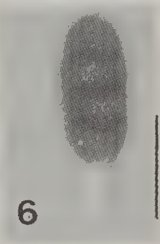
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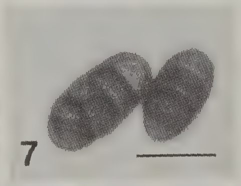
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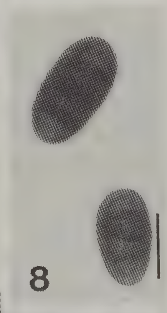
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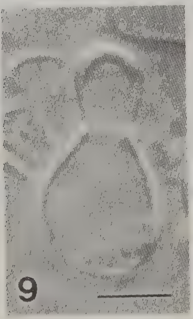
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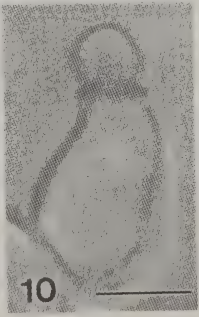
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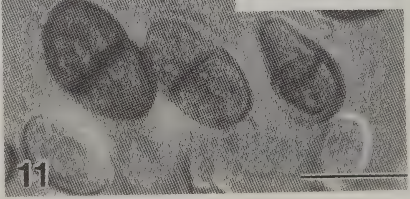
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NOTES: *Camarosporium* Schulzer is a widespread genus comprising approximately 100 species (Hawksworth et al. 1995), which represent anamorphs of *Cucurbitaria* Gray, *Leptosphaeria* Ces. & De Not. and *Pleospora* Rabenh. ex Ces & De Not. (*Cucurbitariaceae, Dothideales*) (Hawksworth et al. 1995). These collections were identified as *Camarosporium* according to Sutton (1980), as they form unilocular pycnidia with annellidic conidiogenous cells and muriform, euseptate conidia. They were also compared to other similar genera such as those discussed by Ramaley (1995, 1997) and Crous and Palm (1999).

Camarosporium sp. is not described to species level, as Sutton (1980) notes that *Camarosporium* is in need of revision, which should not involve any approach based on host specificity. As no revision has been carried out, and it is unfeasible to compare this species with all the other *Camarosporium* spp., no attempt is made to name these collections. However, it is illustrated and described here as cultures are available, which not only provide further characteristics for identification, but these cultures can be used in molecular studies which are likely to be important in the revision of this genus. It is possible that these collections represent the anamorph of one of the *Leptosphaeria* and *Pleospora* spp. which were also recorded in the study, and of which connections in culture could not be confirmed.

Coniothyrium septatum Joa.E.Taylor & Crous, sp. nov.

Figs. 12–17

Conidiomata pycnidialia, subepidermalia, amphigena, discreta, atrobrunnea 90–130 µm diam.; in sectione globosa ad subglobosa, ostiolata, 130–180(–230) µm alta × (150–)130–160(–200) µm diam. Peridium ex exterioribus stratis cellularum brunnearum texturae angularis, introrsum pallescens et hyalinum factum, (12–)14–23 (–32) µm. Conidogenae cellulae hyalinae, discretae, laeves, pyriformes ad ampulliformes, determinatae vel indeterminatae, 4–6(–7) × 3–5(–6) µm; conidiogenesis holoblastica, 1–3-plo enteroblastice et percurrenter proliferantes. Conidia fusiformia interdum ad septum angustata, pallide ad atro luteo-brunnea, parietibus crassis, laevia, (0–)1-medium septum, apice obtuso, base obtusirotundata ad truncata, (8–)10.5–11.5(–13) × (4.5–)5–5.5(–6) µm.

ETYMOLOGY: Referring to the medianly euseptate spore of this species.

Figs. 1–11. *Camarosporium* sp. (PREM 56474) Fig. 1. Conidiomata on host substrate. Fig. 2. Conidioma in cross section. Figs. 3 and 4. Conidiogenous cells showing wide phialides (arrowed). Figs. 5, 7 and 8. Conidia *in vivo*. Fig. 6. Germinating conidium. Figs. 9 and 10. Conidiogenous cells *in vitro*. Fig. 11. Conidia *in vitro*. Scale bars: 1 and 2 = 100 µm; 3–8 and 11 = 10 µm; 9 and 10 = 5 µm.

Leaf spots amphigenous, irregular, grey to light brown with a raised, dark brown border, mainly associated with leaf margins, 3–17 mm. Conidiomata pycnidial, subepidermal, substomatal, separate, visible as dark brown spots, 90–130 µm (Fig. 12); in section, globose to subglobose, with a central apapillate ostiole, 130–180(–230) µm high × (150–)130–160(–200) µm diam. (Fig. 15). Peridium consisting of two strata of cells in a textura angularis, outer stratum of thick-walled brown cells, becoming thinner walled and hyaline inwardly, (12–)14–23(–32) µm, often thicker surrounding ostiole (Fig. 17). Conidiophores reduced to conidiogenous cells. Conidiogenous cells hyaline, discrete, smooth, pyriform to ampulliform, determinate to indeterminate, 4–6(–7) × 3–5(–6) µm (Figs. 13 and 14); conidiogenesis holoblastic, proliferating 1–3 times enteroblastically and percurrently. Conidia fusiform, occasionally narrowing at the septum, thick-walled, pale to dark yellow-brown, smooth to finely verruculose, euseptate, (0–)1-median septum, apex obtuse, base truncate, (8–)10.5–11.5(–13) × (4.5–)5–5.5(–6) µm (Figs. 16).

CULTURAL CHARACTERISTICS: On MEA at 25° in the dark, colonies circular with entire margins, white on both surfaces, becoming olivaceous (23'"b) in the centre. Sparse, fine cottony aerial mycelium. Colonies slow growing, reaching 20 mm diam. after 28 days.

HOLOTYPE: U.S.A.: California, Santa Barbara, leaf spot on *Leucospermum cordifolium*, 8 Apr. 1998, L. Swart (JT 455, PREM 56499).

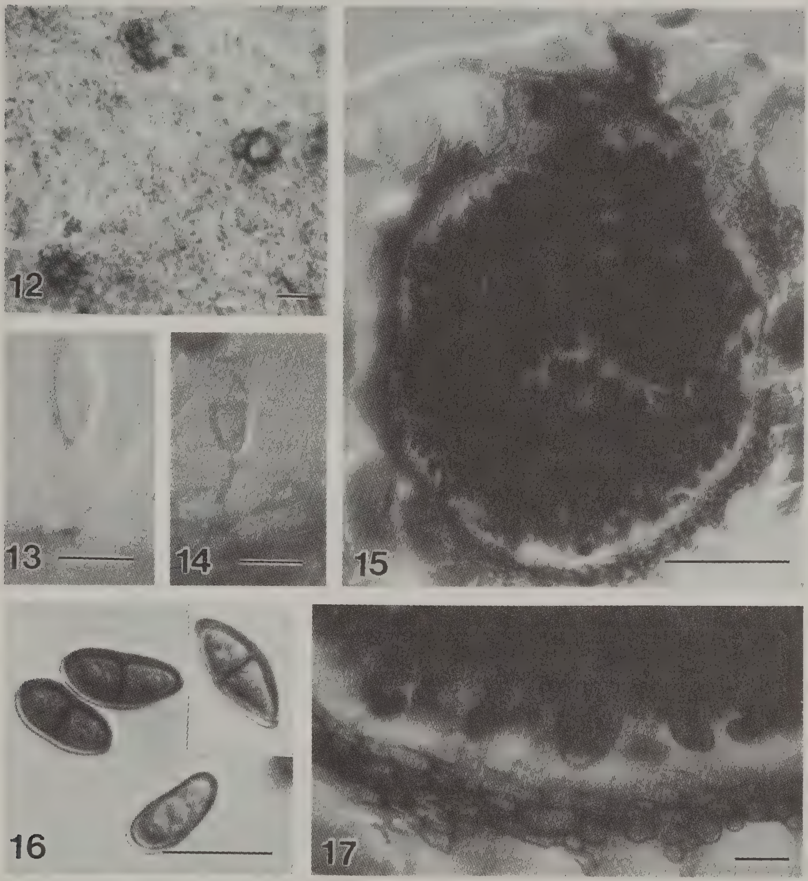
ADDITIONAL SPECIMENS EXAMINED: U.S.A.: California, Santa Barbara, leaf spot on *Protea laurifolia* Thunb., 8 Apr. 1998, L. Swart (JT 495, PREM 56501). CANARY ISLANDS: Tenerife, Proteas da Canarias, leaf spot on *Leucospermum* 'High Gold', 5 Apr. 2000, J.E. Taylor & S. Denman (JT1145, PREM 56864, STE-U 3737-3739); Tenerife, La Laguna University Experimental Farm, leaf spot on *Protea* 'Susara', 5 Apr. 2000, J.E. Taylor & S. Denman (JT1154, PREM 56865, STE-U 3740-3742).

TELEOMORPH: Unknown.

HOST RANGE: *Leucospermum cordifolium, Leucospermum* 'High Gold', *Protea laurifolia* and *Protea* 'Susara'.

GEOGRAPHIC DISTRIBUTION: U.S.A. (California) and Canary Islands (Tenerife).

NOTES: *Coniothyrium* spp. are commonly associated with necrotic leaf spots of proteas (Swart et al. 1998, J.E. Taylor and P.W. Crous, unpubl. data). Although no isolates were obtained from the Californian material, cultures were obtained from collections made in Tenerife. *Coniothyrium septatum* is very distinctive in having predominantly 1-septate conidia, differing from other species of *Coniothyrium* Corda, and especially from those known from proteas (Swart et al. 1998, J.E. Taylor and P.W. Crous, unpubl. data).



Figs. 12–17. *Coniothyrium septatum* (holotype). Fig. 12. Conidiomata on host substrate. Figs. 13 and 14. Conidiogenous cells. Fig. 15. Conidioma in cross section. Fig. 16. Conidia. Fig. 17. Peridium. Scale bars: 12 = 100 µm; 15 = 50 µm; 13, 16 and 17 = 10 µm; 14 = 5 µm.

Morphologically it most closely resembles *Coniothyrium nitidae* Crous & S. Denman, although the conidial dimensions of the latter are smaller (6.5–)8–9(–11) x 3–4(–4.5) µm (Swart et al. 1998).

Didymosphaeria futilis (Berk. & Broome) Rehm, Hedwigia 18: 167 (1879). Figs. 18–24

Leaf spots circular to irregular, discrete to confluent, necrotic, sunken with a raised dark brown margin and with conspicuous black ascomata in the dead tissue, 4–20 mm diam. (Fig. 20). Ascomata amphigenous, immersed to semi-immersed, non-erumpent, black, singular, scattered, 180–320 µm diam. (Fig. 22); in section, substomatal, subepidermal, pyriform or globose with a papillate periphysate ostiole, that appears slot-like in some sections, 190–225 µm high × 180–210 µm diam., with a clypeus surrounding the ostiole, consisting of host cells filled with fungal hyphae (Fig. 18). Peridium comprising two strata of textura intricata, an outer stratum of mid brown, thick-walled cells, becoming hyaline and thin-walled inwardly, 22–30 µm at the sides and thicker at the base, 20–50 µm (Fig. 19). Pseudoparaphyses trabecular, numerous, anastomising in between the asci, 1–2 µm (Figs. 24). Asci cylindrical, tapering gradually to a long pedicel, with a rounded apex with an indistinct ocular chamber, 8-spored, bitunicate, (58–)64–78(–90) × (5.5–)6–6.5(–7) µm (Figs. 24). Ascospores slightly overlapping, uniseriate, ellipsoidal, medium red-brown, median distoseptate, fine spinulose ornamentation, (7.5–)8.5–10.5(–12) × (3.5–)4–4.5(–6) µm (Figs. 21 and 23).

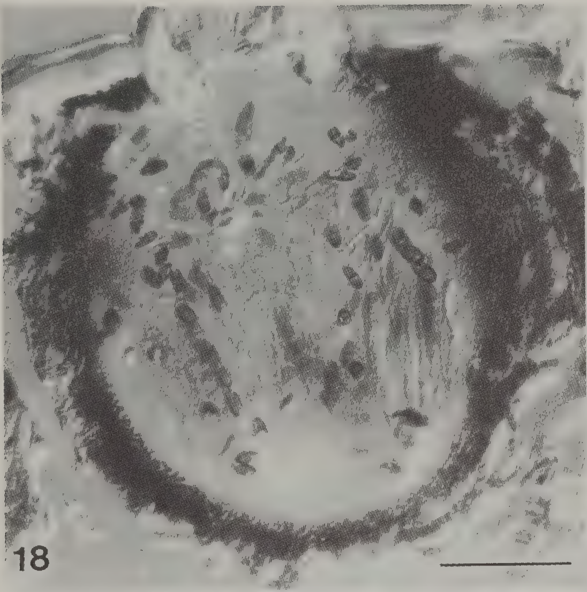
SPECIMENS EXAMINED: U.S.A.: California, UC Santa Cruz, Arboretum, *Protea magnifica* Link, 4 Apr. 1998, L. Swart (JT485, PREM 56502); SOUTH AFRICA: Western Cape, Gouriqua, Reins Nature Reserve, leaf spots on *Protea susannae* E. Phillips, 8 Apr. 1998, L. Dreyer (JT705, PREM 56548); Western Cape, Kirstenbosch, leaf spots of *Protea* sp., Sept. 1932, I.B. Pole-Evans (PREM 26414); Western Cape, on stem of *Leucadendron* sp, 27 May 1999, L. Swart (JT829, PREM 56549).

ANAMORPH: Phoma-like coelomycete and *Fusicladiella* Höhn. synanamorph (Aptroot 1995a), though none observed in these collections.

HOST RANGE: In and on stems, wood and leaves of various plants (Aptroot 1995a); *Leucadendron* sp., *Protea magnifica, P. susannae* and *Protea* sp.

GEOGRAPHIC DISTRIBUTION: Cosmopolitan (Aptroot 1995a).

Figs. 18–24. *Didymosphaeria futilis* (PREM 26414). Fig. 18. Ascoma in cross section. Fig. 19. Peridium. Fig. 20. Lesions on leaves of *Protea* sp. Figs. 21 and 23. Ascospores. Fig. 22. Ascomata on host substrate. Fig. 24. Ascus. Scale bars: 22 = 100 µm; 18 = 50 µm; 19, 21, 23 and 24 = 10 µm.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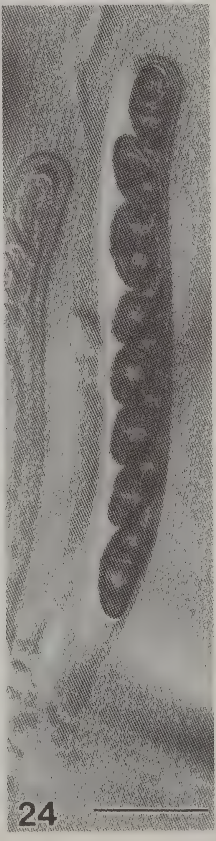
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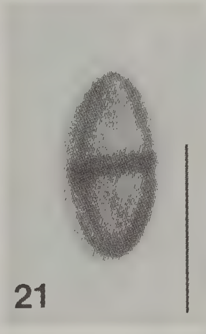
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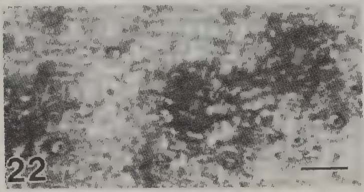
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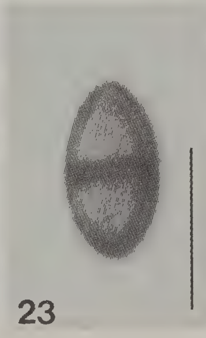
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NOTES: *Didymosphaeria futilis* appears to be commonly associated with lesions of *Proteaceae*. Although we suspect that this species is a saprobe (Aptroot 1995a, b), *Didymosphaeria* Fuckel is still listed on the U.S. Actionable Pathogen List for proteas (Mary Palm, pers. comm.). As no comprehensive description or illustrations could be found for this fungus, it is described here in full for the benefit of quarantine officers and plant pathologists studying protea diseases.

Elsinoë fecunda Joa.E.Taylor & Crous, sp. nov.

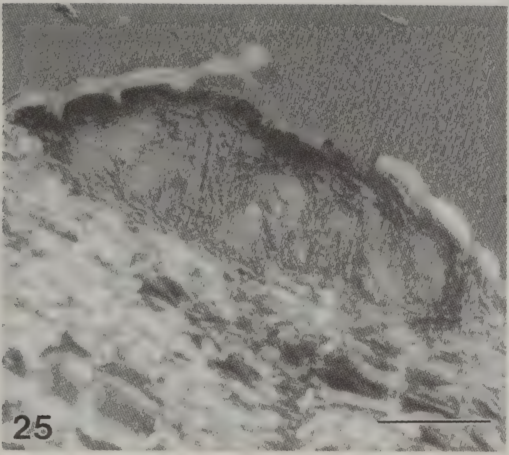
Figs. 25–31

Ascomata dispersa, separata; in sectione pulvinata, intra epidermide, unilocularia vel multilocularia 125–175 µm diam. × 40–65 µm lata. Peridium compositum ex textura angulare, pseudoparenchymatica pallido vel medio brunnea, 7–18 µm. Asci diffusi irregulariter ubique in ascomate, saccati, clavati et obclavati cum extremis rotundatis, crasso pariete, octospori, sessiles, hyalini, (20–)26–28(–33) × (12–)15–16.5(–20) µm. Ascospori hyalini, late ellipsoidei cum extremis rotundatis vel obtusis, cum 1–4 septis transversalibus et 0–2 septis verticalibus, interdum constricti ad septum medianum, (10–)11.5–12.5(–15) × (4–)4.5–5(–5.5) µm.

ETYMOLOGY: From the Latin *fecundus* meaning 'prolific', in reference to the abundant production of ascomata of this *Elsinoë* species.

Lesions visible as regularly scattered small black specks on the twigs and some leaves (Fig. 30); typical corky and scab-like lesions not observed. Ascomata separate and singular, circular to irregular, 70–200 µm diam. (Fig. 30); in section, pulvinate, intraepidermal, single or multilocular, 125–175 µm diam. × 40–65 µm high, with a thin wall of compressed cells between individual locules and each locule possessing an ostiolar opening (Fig. 25). Peridium composed of medium to dark brown pseudoparenchymatic textura angularis, becoming paler and thin-walled inwardly and extending between asci, 7–18 µm (Fig. 28). Hamathecium absent. Asci attached at the base of the ascoma and distributed irregularly throughout, saccate, broadly clavate and obclavate, thick-walled, 8-spored, hyaline, sessile, with a broad rounded tip and a well developed ocular chamber, (20–)26–28(–33) × (12–)15–16.5(–20) µm (Figs. 26 and 27). Ascospores multiseriate, hyaline, broadly ellipsoid with rounded to obtuse ends, widest just above first formed septum, 1–4 transversely septate, and 1–2 vertical septa, oblique septa rare, occasionally constricted at median septum, (10–)11.5–12.5(–15) × (4–)4.5–5(–5.5) µm (Figs. 29 and 31).

Figs. 25–31. *Elsinoë fecunda* (holotype). Fig. 25. Ascoma in cross section. Figs. 26 and 28. Asci. Fig. 27. Peridium. Figs. 29 and 31. Ascospores with sheath (arrowed in 31). Fig. 30. Ascomata on host substrate. Scale bars: 30 = 100 µm; 25 = 30 µm; 26–29 and 31 = 10 µm.



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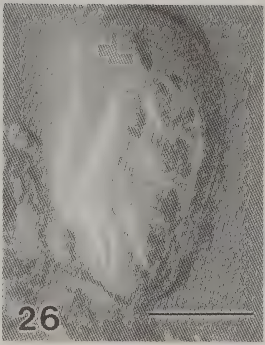

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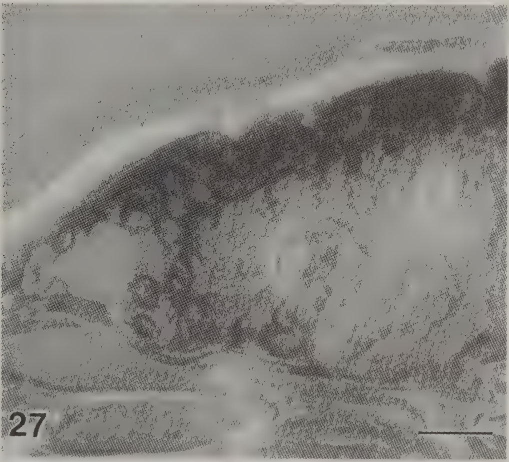

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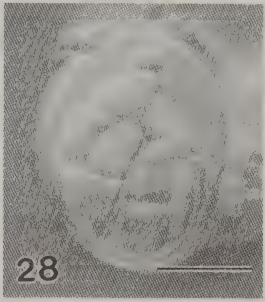

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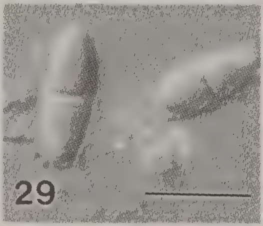

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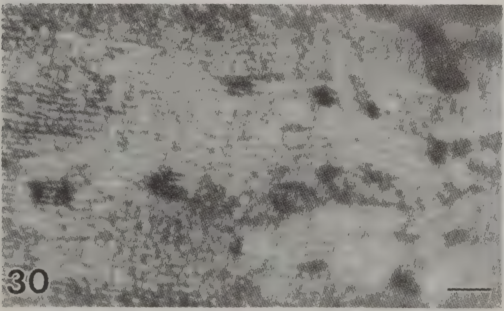

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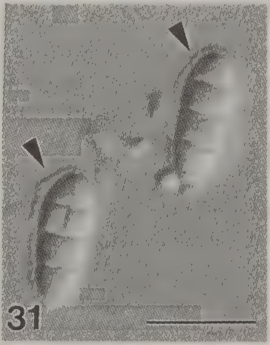

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HOLOTYPE: U.S.A.: California, San Diego, leaf spot on *Protea scolymocephala* (L.) Reichard, 12 Apr. 1998, L. Swart (JT 390, PREM 56503).

ANAMORPH: *Sphaceloma* state not observed.

HOST RANGE: *Protea scolymocephala.*

GEOGRAPHIC DISTRIBUTION: U.S.A. (California).

NOTES: There are over 40 species of *Elsinoë* Racib., which occur mainly in warmer parts of the world (Hawksworth et al. 1995). *Elsinoë* is a member of the *Elsinoaceae* (*Dothideales*) and produces a *Sphaceloma* de Bary anamorph. Members of this genus are biotrophic or necrotrophic on plants, causing scab diseases of fruits, leaves and stems of many cultivated hosts (Arx 1987). Host specificity is unclear at this stage as many species have been described, but are indistinguishable from each other by morphological characters (Arx 1987) or symptoms. Molecular studies are presently addressing this problem, and at least four distinct species of *Elsinoë* (or the *Sphaceloma* anamorph) have been described from proteaceous hosts (Benic and Knox-Davies 1983; Swart et al. 2000a).

Elsinoë spp. are regarded as serious pathogens of cultivated proteas in parts of Australia (Pascoe et al. 1995) and southern Africa (Swart et al. 2000a) and is thought to be distributed via apparently healthy nursery material. This type of distribution has possibly also occurred on an international scale, therefore all new disease records are regarded as of great importance to the protea industry.

This collection is not considered to be conspecific with any of the previously described species from *Proteaceae* (Benic and Knox-Davies 1983; Swart et al. 2000a). Its disease symptoms differ markedly from the characteristic ‘scab’ symptoms associated with *Sphaceloma protearum* L. Swart & Crous. Of the other species isolated from *Proteaceae*, *Elsinoë fecunda* most closely resembles *Elsinoë leucospermi* L. Swart & Crous, but can be distinguished in that ascospores of the latter species lack a sheath. Disease symptoms are also much less severe than those associated with *E. leucospermi* (Benic and Knox-Davies 1983).

The origin of *E. fecunda* is unclear, as *P. scolymocephala* has been introduced into California. Therefore, it is possible that this fungus was derived from another host. Molecular studies have shown that *Elsinoë* spp. on *Proteaceae* have wide host ranges within the family (Swart et al. 2000a). Whether some species of *Elsinoë* are truly plurivorous, however, is uncertain at this stage.

This was not the only record of scab disease on proteas in California. *Elsinoë leucospermi* was isolated from diseased *Leucospermum* spp. (Table 1). In addition, a severe scab disease of

Protea mundii Klotzsch was also observed. However, only the morphologically conserved anamorph was present, so the identity of the species on this host remains uncertain.

Mycosphaerella leucospermi Crous & Joa.E.Taylor, sp. nov.
Figs. 32–34

Maculae amphigenae, circulares ad irregulares, morboscentes. Mycelium internum et externum, septatum, medio brunneum, verruculosum, usque ad 5 µm latum. Ascomata amphigena, sub stomate, intra epidermide vel sub epidermide, erumpescentia, globosa ad subglobosa, ostiolata. Paries compositus ex 2–3 stratis texturae angularis medio brunneis. Asci octospori, sine paraphyse, fasciculati, subsessiles, obovoidei, recti vel leviter incurvati, 40–64 × 8–20 µm. Ascosporae biseriatae ad multiseriatae, guttulatae, cum parietibus crassis, rectae ad leviter incurvatae, fusiformes-ellipsoideae, cum extremis obtusis, latissimae ad medium cellulae apicalis, decrescentes in utraque extrema sed magis manifeste in inferiorem extremum, pallide brunneae et constrictae ad septum factae; ascosparae brunneae et subtiliter verruculosae post dimissum factae, (15–)17–20 × (4–)5–6(–7) µm.

ETYMOLOGY: In reference to the host, *Leucospermum,* from which the type is recorded.

Leaf spots amphigenous, subcircular to irregular, 3–10 mm diam., grey, surrounded by a thin, raised, brown border. Mycelium internal and external, consisting of branched, septate hyphae, medium brown, finely verruculose, up to 5 µm wide. Ascomata amphigenous, sparsely distributed, intra to subepidermal, substomatal, becoming erumpent, globose to subglobose, up to 150 µm wide and 130 µm high (Fig. 32); apical ostiole up to 20 µm wide; wall consisting of 2–3 layers of medium brown textura angularis. Asci 8-spored, aparaphysate, fasciculate, subsessile, obovoid, straight to incurved, apical chamber inconspicuous or minute, 40–64 × 8–20 µm (Fig. 34). Ascospores bi- to multiseriate, guttulate, thick-walled, straight to slightly curved, fusoid-ellipsoidal with obtuse ends, widest in the middle of apical cell, tapering to both ends but more prominently to lower end, becoming pale brown and constricted at septum; ascospores become brown and finely verruculose after discharge, (15–)17–20 × (4–)5–6(–7) µm (in lactophenol) (Fig. 33).

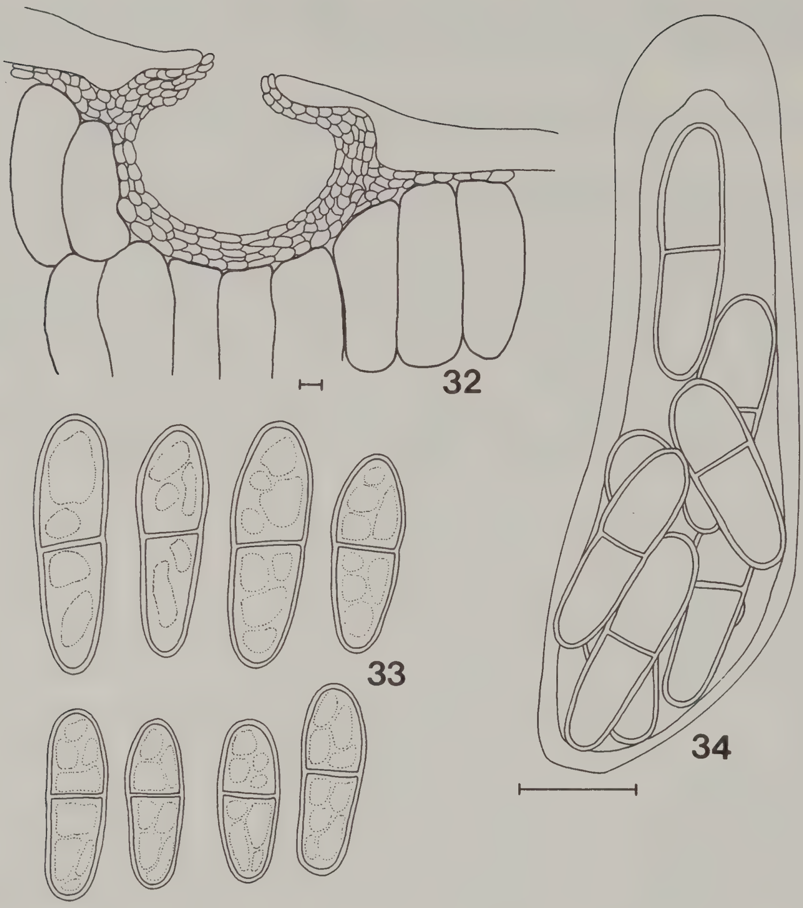
HOLOTYPE: U.S.A.: California, Santa Barbara, on leaf spot on *Leucospermum cordifolium,* 8 Apr. 1998, L. Swart (JT454, PREM 56524).

ADDITIONAL SPECIMENS EXAMINED: U.S.A.: California, Santa Barbara, on leaf spot on *Protea laurifolia,* 8 Apr. 1998, L. Swart (JT493, PREM 56526); *ibid.,* on leaf spot on *Protea cynaroides* (JT501, PREM 56525).

ANAMORPH: Unknown.

HOST RANGE: *Leucospermum cordifolium, Protea laurifolia* and *P. cynaroides.*

GEOGRAPHIC DISTRIBUTION: U.S.A. (California).



Figs. 32–34. *Mycosphaerella leucospermi* (holotype). Fig. 32. Conidioma in cross section. Fig. 33. Ascospores. Fig. 34. Ascus. Scale bars: 32–34 = 10 µm.

NOTES: These collections represent a distinctive species of *Mycosphaerella* pathogenic to *Proteaceae*, and although the anamorph is lacking and cultures of this pathogen are not available, it is considered to be characteristic enough to describe as new. Using the key to *Mycosphaerella* spp. occurring on these host genera (Taylor and Crous 2000), *M. leucospermi* is found to most closely resemble *M. jonkershoekensis* P.S. van Wyk, Marasas & Knox-Dav.

(Van Wyk et al. 1975; Taylor and Crous 1998). The ascospores of *M. jonkershoekensis,* however, differ in morphology in having a longer lower cell, and are narrower (10.5–)18–19.5(–23) × (4–)4.5–5(–6) µm (Taylor and Crous 1998). It is possible that *M. leucospermi* is derived from another host, as these proteas are introduced into California. Further collections need to be made to determine the anamorph connection and for cultures to be made available for molecular studies.

Mycosphaerella sp.

Figs. 35–38

Lesions caulicolous and foliicolous, inconspicuous on stems, but circular and amphigenous on leaves, 1–8 mm diam., surrounded by a dark brown, raised border, and a thin, chlorotic margin. Mycelium internal and external, consisting of branched, septate, medium brown, finely verruculose hyphae, up to 5 µm wide. Ascomata amphigenous, evenly distributed, black, intra- to subepidermal, becoming slightly erumpent, substomatal, subglobose, up to 100 µm wide and 60 µm high (Fig. 36); apical ostiole 10–15 µm wide; wall consisting of 3–4 layers of brown textura angularis, up to 10 µm thick. Asci aparaphysate, fasciculate, bitunicate, subsessile, obovoid to ellipsoid, straight to incurved, 8-spored, 28–50 × 8–11 µm (Fig. 38). Ascospores tri- to multiseriate, hyaline, not to sparsely guttulate, fusoid-ellipsoidal with obtuse ends, widest just above the septum, tapering more prominently towards the lower end, not constricted at the septum, thick-walled, (9–)10–11(–12) × 3–3.5 µm (in lactophenol) (Fig. 37).

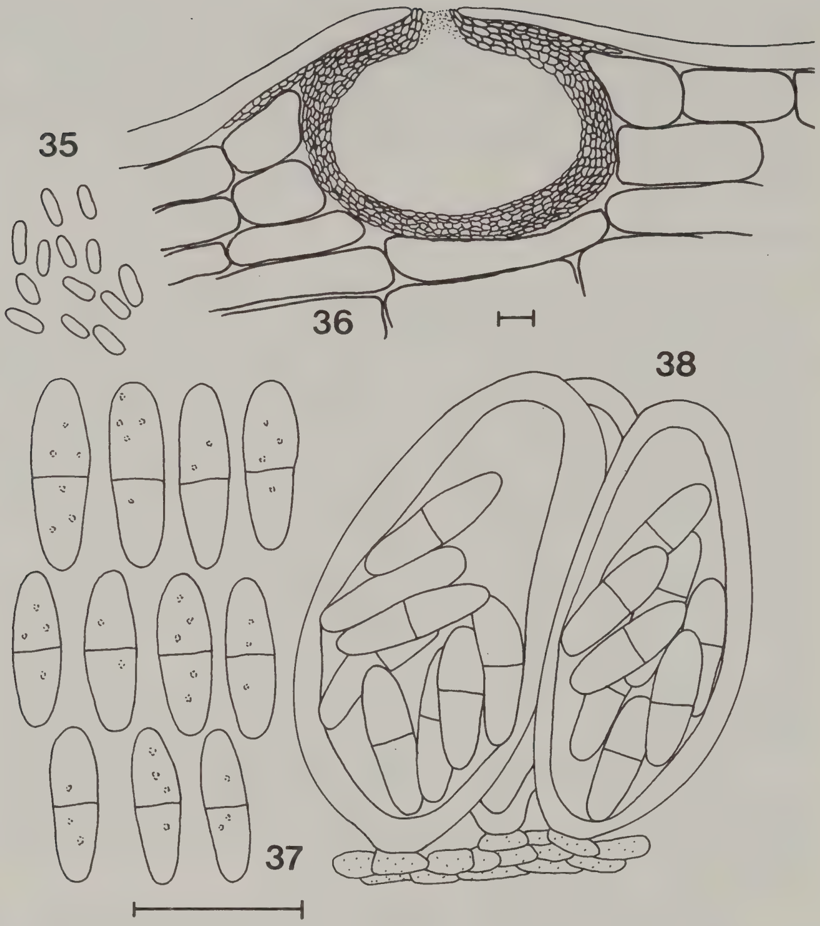
SPECIMENS EXAMINED: U.S.A.: California, San Diego, on leaf spot of *Protea cynaroides*, 12 Apr. 1998, L. Swart (JT286, PREM 56522); California, Arboretum, UC Santa Cruz, on leaf spot of *Protea eximia* (Salisb. ex Knight) Fourc., 4 Apr. 1998, L. Swart (JT439, PREM 56523); California, Santa Barbara, on leaf spot on *Leucospermum cordifolium*, 8 Apr. 1998, L. Swart (JT 452, PREM 56521).

ANAMORPH: Unknown.

HOST RANGE: *Leucospermum cordifolium, Protea eximia* and *P. cynaroides.*

GEOGRAPHIC DISTRIBUTION: U.S.A. (California).

NOTES: These collections represent a species of *Mycosphaerella*, that in the absence of cultures and anamorph details, would be difficult to distinguish from the complex recognised by Taylor and Crous (2000). For this reason no specific name has been appointed. In dimensions, this pathogen is similar to *Mycosphaerella bellula* Crous & M.J. Wingf.(Crous and Wingfield 1993; Taylor and Crous 1998). However, the ascospores are not constricted at the septum, are slightly narrower and lack a distinctive sheath (Taylor and



Figs. 35–38. *Mycosphaerella* sp. (PREM 56522). Fig. 35. Spermatia. Fig. 36. Conidioma in cross section. Fig. 37. Ascospores. Fig. 38. Asci. Scale bars: 35–38 = 10 µm.

Crous 1998), and could possibly represent yet another species. A description of this pathogen is given here in anticipation of future collections, when the information necessary for identification or full description may be available.

Stigmina californiae Joa.E.Taylor & Crous, sp. nov.

Figs. 39–46

Sporodochia amphigena, numerosa, atro-brunnea ad nigra, punctiformia, (70–)80–140(–200) µm, consociata cum maculis morboscentibus luteis ad pallide brunneis et depressis, cum marginibus extantibus, 4–25 mm diam. Mycelium superficiale, rubro-brunneum, cum parietibus crassis, verruculosum, constrictum ad septa, reticulatum et crustam quasi stratum infra et inter sporodochia formans, 7–9(–10) µm. Stromata ex stomatibus emergentia, formantia superficiales massas sporodociorum contiguorum. Conidiophora cylindrica, decrescentia ad cellulas conidiogenas, in fasciculis laxis, ex stromate exorientia, macronemata, recta vel flexuosa, praecipue simplicia, rubro-brunnea, tenuiter verruculosa et cum striis, (8–)14–24(–60) × (5–)6–6.5(–7) µm. Cellulae conidiogenae cylindricae, medio rubro-brunneae, subtiliter verruculosae, indeterminatae cum 0–4 annellatis irregularibus et asperis (5–)9.5–13(–17) × (4–)5–6 µm. Conidia cylindrica, fusiformia vel obclavata, cum base truncata et decrescentia ad apicem rotundatem, recta, luteo-brunnea, subtiliter verruculosa, 0-3 distoseptata, (11–)14–16(–19) × (3–)5–5.5(–7) µm.

ETYMOLOGY: In reference to the place where this fungus was first collected.

Sporodochia amphigenous, numerous, dark brown to black, punctiform, (70–)80–140(–200) µm, associated with yellow to pale brown, sunken, necrotic leaf spots, with raised borders, 4–25 mm diam. (Fig. 39). Mycelium superficial, red-brown, thick-walled, finely verrucose, constricted at the septa, reticulate and forming a crust-like layer beneath and in between sporodochia, 7–9(–10) µm (Fig. 41). Stromata emergent from stomata, forming superficial masses of adjoining sporodochia (Fig. 41). Conidiophores cylindrical, tapering to the conidiogenous cells, in loose fascicles, arising form the stromata, macronematous, straight or flexuous, mainly simple, red-brown, finely verrucose and with striations, (8–)14–24(–60) × (5–)6–6.5(–7) µm (Fig. 46). Conidiogenous cells cylindrical, medium red-brown, finely verrucose, indeterminate with 0–4 irregular, roughened annellations (5–)9.5–13(–17) × (4–)5–6 µm (Figs. 44 and 45). Conidia cylindrical, fusiform or obclavate, with a truncate base and tapering to a rounded apex, straight, yellow-brown, finely verrucose, 0–3 distoseptate, (11–)14–16(–19) × (3–)5–5.5(–7) µm (Figs. 40, 42 and 43).

HOLOTYPE: U.S.A.: California, Santa Barbara, leaf spot on *Protea* 'Pink Ice', Apr. 1998, L. Swart (JT 383, PREM 56541).

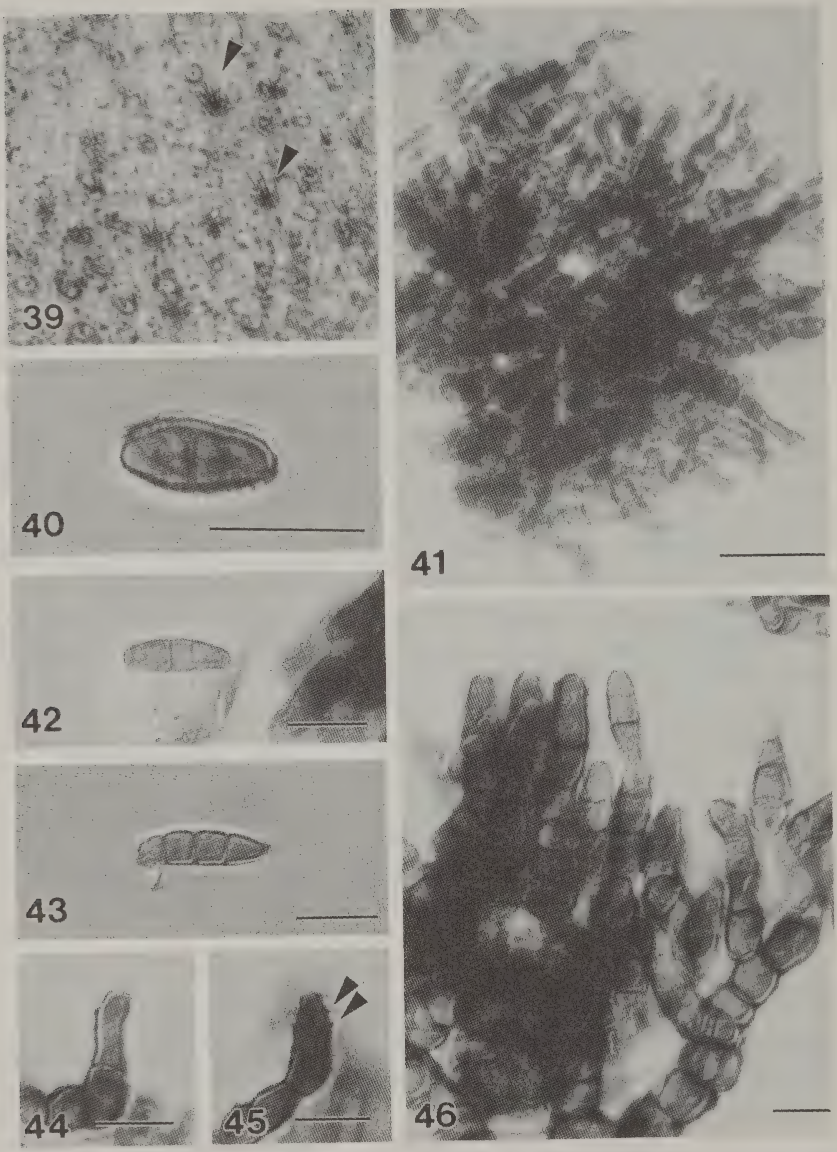
ADDITIONAL SPECIMENS EXAMINED: U.S.A. California, Santa Barbara, leaf spot on *Protea laurifolia*, 8 Apr. 1998, L. Swart (JT 491, PREM 56542); California, Santa Cruz, leaf spot on *Protea magnifica*, 5 Apr. 1998, L. Swart (JT 472, PREM 56543).

TELEOMORPH: Unknown.

HOST RANGE: *Protea laurifolia, Protea magnifica* and *Protea* 'Pink Ice'.

GEOGRAPHIC DISTRIBUTION: U.S.A. (California).

NOTES: The widespread genus *Stigmina* Sacc. has recently been reviewed by Sutton (1989). The collections above subscribe to this generic delimitation, and differ from allied genera (Braun et al. 1999).



Figs. 39–46. *Stigmina californiae* (holotype). Fig. 39. Sporodochia on host substrate. Figs. 40, 42 and 43. Conidia. Fig. 41. Sporodochium and superficial mycelium. Figs. 44 and 45. Conidiogenous cells showing annellides (arrowed). Fig. 46. Conidiophores and conidiogenous cells. Scale bars: 41 = 30 µm; 39 and 40, 42–46 = 10 µm.

The spores are distoseptate, and therefore these collections belong in *Stigmina,* rather than *Scolecostigmina* U. Braun, which has pigmented, euseptate, scolecosporous conidia (Braun et al. 1999). These collections do not correspond to any other previously described species of *Stigmina sensu stricto* as the spore length is smaller (Hughes 1953; Ellis 1971, 1976; Sutton and Pascoe 1989).

Three varieties of *Cercostigmina protearum* (Cooke) U. Braun & Crous have been described from proteaceous hosts in South Africa (Crous and Braun 1994, 1996), as well as three species of *Batcheloromyces* Marasas, P.S. van Wyk & Knox-Dav. (Marasas et al. 1975; Van Wyk et al. 1985; Taylor et al. 1999). *Batcheloromyces* is restricted to proteaceous hosts in South Africa [although one species, *B. leucospermi*, was collected in California (Table 1)], and was included in generic synonymy of *Stigmina* by Sutton and Pascoe (1989), but not by Taylor et al. (1999). However, none of the species of the aforementioned genera correspond to the collections made in California.

DISCUSSION

This study provides baseline data on the status of diseases of proteas in California (Table 1). It also summarizes the data collected on proteas from other states, excluding Hawaii, where proteas are cultivated (Farr et al. 1989) and of specimens intercepted by quarantine (Table 1). All of the identified fungi are deposited at PREM, unless otherwise stated. The associated symptoms and the occurrence of the disease in South Africa are also noted (Table 1).

An overall impression of protea plantations in the protea production regions of California suggests that they show generally little symptoms of disease. In the few plantations, however, where the most devastating diseases of proteas in California are present, the diseases result in significant losses of stems and even entire plants. Plants that are stressed due to nutritional factors are more prominent (Perry 1998), although these stressed plants are also more susceptible to diseases (Schoeneweiss 1975). So far the most serious diseases recorded in California have been Botrytis blight of flowers, and root diseases such as quick die-back (probably caused by species of *Phytophthora* de Bary and/or *Pythium* Pringsh.) (Perry 1998).

In this study of mainly leaf and stem diseases, Botryosphaeria stem canker caused by *Botryosphaeria dothidea* was the most devastating disease found on older *Protea* and *Leucadendron* plants, that were probably more subjected to stress. In some regions (central and southern parts of California) and on certain farms, entire plantations were destroyed by the canker pathogen. This cosmopolitan pathogen with its very wide host range (Brown and Hendrix 1981), probably spread from other host plants nearby. In South Africa, this is also probably the most important canker causing pathogen (Von Broembsen and Van der Merwe 1990) affecting woody stems, and research into integrated disease management programmes is currently being undertaken (S. Denman, pers. comm.).

Botryosphaeria proteae caused leaf spots on various *Protea* species, as did a currently unidentified *Fusicoccum* sp., but neither were as devastating as *B. dothidea*. *Botryosphaeria proteae* has recently been treated by Denman, Crous and Wingfield (1999), and was possibly introduced to California as an endophyte, as it is commonly isolated from surface sterilized leaves of *Protea* and *Leucospermum* spp. (Swart et al. 2000b). *Fusicoccum* sp. has been found associated with leaf spots of proteas in South Africa and other areas where proteas are cultivated. Currently, molecular studies are being carried out in order to determine the correct identity of this pathogen (S. Denman, pers. comm.). It is possible that it is either a common widespread pathogen, or has been distributed endophytically on seed, as it has also been isolated in endophyte studies (J.E. Taylor, unpubl. data). This pathogen broadly resembles *Fusicoccum aesculi,* but in culture it differs in that it produces grey and woolly mycelium, compared to the former, of which the culture is black in colour and the mycelium is only woolly at the edges. In addition, the conidia of *Fusicoccum* sp. differ as they do not taper to the apices, but are oblong with a fairly broad obtuse apex, narrowing slightly to a truncate base with a minute basal frill and are wider (22–) 27–30(–33) × (7–)8.5–9.5(–11) µm, compared to 18–25(–30) × 4–4.5(–5) µm for *F. aesculi* (Crous and Palm 2000).

Coleroa leaf spot is the most common leaf spot pathogen (Taylor and Crous 1998), occurring widely on most of the *Protea* cultivars and species in California. Although this pathogen generally affects older growth (Von Broembsen 1989), it can cause financial losses for the producer as it can affect the aesthetic value of the flower, especially when infections are severe. Other common leaf spot pathogens recorded in South Africa, such as *Batcheloromyces* spp. (with the exception of a few collections of *B. leucospermi*) (Taylor et al. 1999), *Cercostigmina* spp. (Crous and Braun 1994), *Leptosphaeria protearum* Syd. & P. Syd., *Teratosphaeria* spp. and *Vizella interrupta* (G. Winter) S. Hughes (Taylor and Crous 1998) were not collected in California. However, there were present other pathogens associated with necrotic leaf spots on *Protea* and *Leucospermum* unrecorded in South Africa, such as those new species reported here, but which appear to be of lesser importance.

In California Elsinoë scab disease can be a very important and devastating disease on *Leucospermum cordifolium* and *Protea mundii*. Heavy losses occurred in one nursery in the early 1980's due to scab disease on *Leucospermum* spp. caused by *Elsinoë leucospermi* (Swart et al. 2000a). The disease has a very limited distribution in California, only occurring in two plantations and one nursery on *L. cordifolium*. The species of *Elsinoë* causing scab symptoms on *P. mundii* is as yet unidentified, and was also detected in one nursery. However, the fact that this disease is found in nurseries can have significant implications for the Californian protea producers since the disease can spread throughout the Californian protea production area by means of infected cuttings or plants (Von Broembsen 1989). The spread of scab infected nursery material already had devastating consequences in Australia (Pascoe et al. 1995) and Zimbabwe (L. Swart, pers. obs.). A number of other protea hosts also displayed symptoms of Elsinoë scab disease (*Leucadendron* 'Silvan Red', *Leucadendron discolor* E. Phillips & Hutch., *Protea cynaroides, Protea magnifica* and *Protea* sp.), but the identity of the causal organisms could not be verified.

The limited range of pathogens and saprophytes recorded on protea plants from California can be partly ascribed to the fact that plant material for identification was only collected once during the spring of 1998. The occurrence of some diseases can be affected by the prevailing climate, for instance, specific climatic conditions are necessary for the development of Botrytis blight, Drechslera blight and Colletotrichum anthracnose (Von Broembsen 1989). Therefore, the absence of these pathogens from the collections made in this study is no indication of their status in plantations in California. More collections need to be made during different seasons of the year in order to be able to obtain a more realistic impression of the range of fungal pathogens associated with proteas in California.

The implications of these findings, and the impact they may have on the status of these fungi as actionable pathogens, is difficult to assess. Unfortunately, the issues in question go beyond the scope of the present study. However, this research does represent the initial stage required by the Sanitary and Phytosanitary Agreement (World Trade Organisation 1994) in the assessment of risk to plant health and the determination of the appropriate level of phytosanitary measures. This must take into account the available scientific evidence, of which prior to this study, there was none.

Table 1: Microfungi recorded from diseased *Proteaceae* hosts. Includes records collected in California during Apr. 1998, records listed in Farr et al. (1989)* and records from quarantine interceptions †.

Pathogen	Host Range	Symptoms	Status in South Africa	State Collected	Reference
Alternaria sp.	*Protea cynaroides*	leaf spot	-	CA	PREM 56463
Anthostomella spartii Berl. & Voglino	*Protea eximia*	leaf spot	N	CA	PREM 56464
Armillaria tabescens (Scop.) Dennis, Orton & Hora	*Grevillea robusta* A. Cunn. ex R. Br.*	root rot	N	FL	(Alfieri et al. 1984)
Batcheloromyces leucospermi J.E. Taylor & Crous	*Protea* sp.	leaf spot	Y	CA	PREM 56465
Botryodiplodia sp.	*Grevillea robusta* †		-	FL	BPI 625084B
Botryosphaeria dothidea (Moug. ex Fr.) Ces. & De Not. (*Fusicoccum aesculi* Corda)	*Leucadendron* 'Silvan Red' *Leucadendron discolor* *Protea cynaroides* *Protea cynaroides* 'Silver Mink' *Protea eximia* *Protea laurifolia* *Protea magnifica* *Protea obtusifolia* H. Buek ex Meisn. *Protea* sp.	Severe pathogen causing leaf spots and stem cankers	Y	CA	PREM 56466 PREM 56467 PREM 56468 PREM 56505 PREM 56469 PREM 56470 PREM 56506 PREM 56507 PREM 56508
Botryosphaeria proteae (Wakefield) S. Denman & Crous (*Fusicoccum proteae* S. Denman & Crous)	*Protea* 'Queen Mink' *Protea cynaroides* *Protea eximia*	leaf spot	Y	CA	PREM 56509 PREM 56471 PREM 56510
Botryosphaeria quercuum (Schwabe) Sacc.	*Grevillea robusta* *	die-back, gumming	-	FL	(Alfieri et al. 1984)
Botryosphaeria sp.	*Grevillea robusta* † *Grevillea* sp. †	-	-	FL	BPI 625084A,B BPI 625082

Botryotinia fuckeliana (de Bary) Whetzel (*Botrytis cinerea* Pers.)	*Protea cynaroides*	blight	Y	CA	PREM 56472
Camarosporium sp.	*Leucospermum cordifolium* *Protea cynaroides*	leaf spot	N	CA	PREM 56473 PREM 56474
Cladosporium spp.	*Leucospermum cordifolium* *Protea* 'Pink Ice' *Protea* 'Queen Mink' *Protea cynaroides* 'Silver Mink' *Protea magnifica* *Protea repens* (L.) L.	leaf spot	-	CA	PREM 56475 PREM 56476 PREM 56477 PREM 56478 PREM 56479 PREM 56480
Coleroa senniana (Sacc.) E. Mull. & Arx	*Leucospermum cordifolium* *Protea* 'May Day' *Protea* 'Pink Ice' *Protea* 'Queen Mink' *Protea* 'White Owl' *Protea laurifolia* *Protea laurifolia* x *neriifolia* *Protea magnifica* *Protea neriifolia* R. Br. *Protea neriifolia* x *magnifica* *Protea obtusifolia* *Protea pudens* Rourke *Protea* sp.	Severe leaf spot pathogen. Biotrophic, sometimes causing necrotic lesions	Y	CA	PREM 56481 PREM 56482 PREM 56483 PREM 56484 PREM 56485 PREM 56486 PREM 56487 PREM 56488 PREM 56489 PREM 56490 PREM 56491 PREM 56492 PREM 56493
Coniothyrium leucospermi Crous & S. Denman	*Protea neriifolia* *Protea obtusifolia* *Protea* sp.	leaf spot	Y	CA	PREM 56495 PREM 56496 PREM 56497
Coniothyrium septatum	*Leucospermum cordifolium* *Protea laurifolia*	leaf spot	N	CA	PREM 56499 PREM 56501
Coniothyrium spp.	*Leucospermum cordifolium* *Protea cynaroides*	leaf spot	-	CA	PREM 56498 PREM 56500

Corticum sp.	*Grevillea robusta* †		-	FL	BPI 1101248
Didymosphaeria futilis	*Protea magnifica*	leaf spot	Y	CA	PREM 56502
Diplodia sp.	*Grevillea robusta** *Grevillea* sp.*	die-back, gumming*	-	FL	(Anonymous 1960; Alfieri et al. 1984)
Elsinoë leucospermi	*Leucospermum cordifolium* *Leucospermum cordifolium* var. Vlam *Leucospermum. glabrum* *Leucospermum. reflexum* var. Luteum	scab	Y	CA	STE-U 2042 STE-U 2041 STE-U 2039 STE-U 2040
Elsinoë fecunda	*Protea scolymocephala*	scab	N	CA	PREM 56503
Fusarium sp.	*Protea cynaroides* *Grevillea robusta**	root rot*	-	CA, FL	PREM 56504 (Alfieri et al. 1984)
Fusicoccum sp.	*Protea compacta* *Protea cynaroides* *Protea eximia* *Protea laurifolia*	leaf spot	Y	CA	PREM 56511 PREM 56512 PREM 56513 PREM 56514
Fusicoccum proteae	See *Botryosphaeria proteae*				
Fusicoccum aesculi	See *Botryosphaeria dothidea*				
Ganoderma zonatum Murrill	*Grevillea robusta**	root rot	-	FL	(Alfieri et al. 1984)
Ganoderma brownii Murrill	*Hakea* sp.*	on wood	-	CA	(Gilbertson and McHenry 1969)
Glomerella cingulata (Stoneman) Spauld. & H. Schrenk (*Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc.)	*Protea cynaroides*	anthracnose	Y	CA	PREM 56494
Kabatiella sp.	*Protea cynaroides*	leaf spot	-	CA	PREM 56515

Leptosphaeria cf. *lonicera* (Fautrey) L. Holm	*Protea magnifica* *Protea neriifolia* x *magnifica* *Protea* sp.	leaf spot	-	CA	PREM 56516 PREM 56517 PREM 56518
Lophiostoma fuckelii Sacc.	*Protea cynaroides* *Protea laurifolia* x *neriifolia*	leaf spot	Y	CA	PREM 56519 PREM 56520
Mycosphaerella leucospermi	*Leucospermum cordifolium* *Protea cynaroides* *Protea laurifolia*	leaf spot	N	CA	PREM 56521 PREM 56522 PREM 56523
Mycosphaerella sp.	*Leucospermum cordifolium* *Protea cynaroides* *Protea eximia*	leaf spot	-	CA	PREM 56524 PREM 56525 PREM 56526
Nectria pseudotrichia Berk. & M.A. Curtis	*Grevillea robusta* † *Grevillea* sp.*		-	FL	BPI 552941 (Petrak 1953)
Penicillium sp.	*Protea cynaroides*	leaf spot	-	CA	PREM 56527
Pestalotiopsis spp.	*Leucospermum cordifolium* *Protea cynaroides* 'Silver Mink'	leaf spot	-	CA	HKU(M)10419 HKU(M)10418
Phomopsis sp.	*Protea cynaroides*	leaf spot	-	CA	PREM 56528
Phymatotrichopsis omnivora (Duggar) Hennebert	*Grevillea robusta** *Grevillea* sp.*	root rot	-	AZ	(Anonymous 1960)
Phytothphora sp.	*Grevillea robusta**	root rot	-	FL	(Alfieri et al. 1984)
Pleospora herbarum (Pers.) Rabenh.	*Leucospermum cordifolium* *Protea* cv. Pink Ice *Protea cynaroides* *Protea magnifica* *Protea* sp.	leaf spot	Y		PREM 56529 PREM 56530 PREM 56531 PREM 56532 PREM 56533
Pleospora spp.	*Protea laurfolia* *Protea magnifica*	leaf spot	-		PREM 56534 PREM 56535

Pyrenochaeta-like sp.	*Grevillia* 'Misty Pink'	leaf spot	-	CA	PREM 56536
Pythium sp.	*Grevillea robusta** *Banksia media* * *Hakea petiolaris**	root rot	-	FL	(Alfieri et al. 1984)
Ramularia sp.	*Grevillea robusta**	leaf spot	-	FL	(Alfieri et al. 1984)
Rhizoctonia solani Kühn.	*Grevillea robusta**	basal stem rot	Y	FL	(Alfieri et al. 1984)
Rhytidhysteron rufulum (Spreng.: Fr.) Speg. (* as *Tryblidiella rufula* (Spreng.: Fr.) Sacc.)	*Grevillea robusta* †* *Grevillea* sp. †		-	FL	(Petrak 1953) BPI 648633 BPI 648219 BPI 648514 BPI 648515 BPI 648212
Sarcostroma grevillieae (Loos) Nag Raj	*Grevillia* 'Misty Pink'	leaf spot	-	CA	PREM 56537
Seimatosporium sp.	*Protea* sp.	leaf spot	-	CA	PREM 56538
Seridium cf. *cardinale* (W.W. Wagener) B. Sutton & I.A.S. Gibson	*Protea* sp.	leaf spot	-	CA	PREM 56539
Seridium sp	*Leucospermum cordifolium*	leaf spot	-	CA	PREM 56540
Stigmina californiae	*Protea* 'Pink Ice' *Protea laurifolia* *Protea magnifica*	leaf spot	-	CA	PREM 56541 PREM 56542 PREM 56543
Truncatella angustata (Pers.: Link) S. Hughes	*Leucospermum cordifolium*	leaf spot	Y	CA	PREM 56544
Zetiasplonza cf. *cordylines* (Speg.) Nag Raj	*Leucospermum cordifolium*	leaf spot	-	CA	PREM 56545

ACKNOWLEDGEMENTS

L. Swart would like to thank the protea producers who allowed her to visit their farms in California, and also the European Union who funded the trip. J.E. Taylor would like to thank S. Velthuysen at PREM for lodging all the herbarium specimens. P.W. Crous would like to thank M. E. Palm (USDA-APHIS-PPQ, Systematic Botany and Mycology Lab., Beltsville) for assistance with specimens lodged at BPI, and also acknowledge the USDA-FAS-ICD-RSED for grant 98IARA6578, and the National Research Foundation for financial support.

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MYCOTAXON

Volume LXXVIII, pp. 105-114 April-June 2001

TYLOPILUS PAKARAIMENSIS SP. NOV., A NEW BOLETE IN TYLOPILUS SECTION POTAMOGETONES FROM GUYANA

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ABSTRACT

Tylopilus pakaraimensis sp. nov. (Boletaceae) is described as new to science. This bolete species was collected from rainforests dominated by ectomycorrhizal *Dicymbe* spp. (Caesalpiniaceae) in the Pakaraima Mountains of western Guyana, South America. *Tylopilus pakaraimensis* is assigned to the neotropical *Tylopilus* section *Potamogetones* based on the unusual spore characteristics and macrochemical reactions. A key is provided for the taxa of *Tylopilus* section *Potamogetones*.

Key Words: Boletaceae, neotropics, basidiomycetes, biodiversity, taxonomy

INTRODUCTION

Recent mycological explorations in the Pakaraima Mountains of western Guyana have revealed a hitherto undocumented region of neotropical forests dominated by ectomycorrhizal species of *Dicymbe* Spruce ex Benth. (Caesalpiniaceae, tribe Amherstieae) (Henkel 1999). Ectomycorrhizal basidiomycete families including the Boletaceae are well represented in these *Dicymbe* forests and taxonomic work on the ectotrophic mycota is progressing (Henkel 1999, Henkel et al. 2000, O.K. Miller et al. 2000, Simmons et al. 2000, S.L. Miller et al. 2000).

This paper is an addition to the author's ongoing taxonomic synopsis of *Tylopilus* P. Karsten known to occur in Guyana (Henkel 1999). A new species, *Tylopilus pakaraimensis*, is described, and the position of this species within the neotropical *Tylopilus* section *Potamogetones* Singer is discussed.

MATERIALS AND METHODS

Three collecting expeditions were conducted during the heavy rainy seasons of May-July in 1997, 1998, and 1999 to the Upper Ireng River Basin along Guyana's western border with Brazil, in the west-central Pakaraima Mountains (general area: 5° 05' N; 59° 58' W). A fourth expedition was conducted during May-July of 2000 to the Upper Potaro River Basin located approximately 40 km north of the Ireng River site. Fungi were collected at both sites at distances 0-5 km from a series of base camps previously established by the author (Henkel et al. 1993, Henkel 1999).

Basidiomata were examined in the field for their fresh characteristics. Color characteristics were described and coded according to Kornerup and Wanscher (1978). Spore deposits were examined for fresh color characteristics. Macrochemical spot tests were performed according to the methods of Singer (1986). Basidiomata were dried slowly over charcoal and subsequently placed in containers with silica gel to prevent spoilage in the excessively humid conditions. Additional collections were dried in the field by placing fresh basidiomata in air-tight containers filled with silica gel beads. This method required frequent changing of the silica gel over a 24-48 h period to insure complete drying of robust Boletaceae.

Microscopic anatomical details were determined from dried specimens with a Leitz Diaplan microscope with bright-field and phase-contrast optics. Dried material was revived in 3% KOH; features were observed in 3% KOH and Melzer's reagent. For spores, basidia, and cystidia at least 20 individuals were observed and measured.

Herbaria designations are according to Holmgren et al. (1990): BRG - University of Guyana, Georgetown; DUKE - Duke University, Durham, North Carolina; F - Field Museum of Natural History, Chicago.

TAXONOMY

Tylopilus pakaraimensis T. W. Henkel, *sp. nov.*
Figs. 1, 2

Tylopilo potamogetoni Singer var. *irengensi* T. W. Henkel similis sed pileo oribusque tuborum lilacinis vel violaceis, reticulo vero in stipite superiore, sporibus brevioribus, pleurocystidiis constanter longioribus, et hyphis erectis fasciculatis in trichodermio stipitis differt.

Macroscopic features. *Pileus* 30-100 mm broad, convex to plano-convex, rarely broadly parabolic, margin occasionally upturned with age, most commonly reddish lilac (14C4-C5) to lilac (15B5-C5), occasionally greyish violet (15D4), rarely dark violet (15F6) throughout, fibrillose-subtomentose, occasionally appearing finely mottled to sub-areolate near center, dry to subviscid in wet weather, with narrow marginal tissue flap inrolled when young; context 2-15 mm thick, white; in fresh specimens context bluing slightly and rapidly when cut, stain then fading. *Odor* minimal; *taste* slightly to moderately bitter.

Tubes 4-8 mm long, greyish orange (6B3-B4), reddish grey (11B3), or greyish rose (12B3-C3), depressed around stipe and occasionally slightly decurrent; *pores* 2 per mm, isodiametric; *tube edges* reddish lilac (14C3) to greyish magenta (14D3) when young, more concolorous with tubes when mature, staining tan to brown slowly when bruised.

Stipe 40-110 mm × 8-20 mm, sub-equal, occasionally broadening slightly near base, reddish brown (8E5-E6), finely fibrillose and macroscopically appearing more or less smooth, often longitudinally striate, with age striations often broadening into a true reticulum over distal ½, reticulum concolorous or with lilac tones, near apex ground color between reticulations off-white, extreme apex whitish to pale lilac, with downy, whitish to dingy cream (4A3-B3) mycelium at base; context solid, white over upper ½, bluing slightly and rapidly when cut, stain then fading, lower ½ rich golden yellow when initially cut, this region then bluing rapidly and more intensely than distal portion, eventually becoming dark brown.

Microscopic features. *Basidiospores* in fresh deposit dull pinkish-flesh (6A3-B3), darker in heavy deposit (near 7C5-C6), (7.3) 8.2-9.9 (11.2) × 5-5.9 μm (mean Q = 1.66), short-ellipsoid with slight suprahilar depression and often somewhat planate on inner side; hyaline to pale golden in KOH, inamyloid to occasionally weakly pseudoamyloid, smooth, wall well-defined, thickened (0.6-1.0 μm), hilar appendage (0.3) 0.5-0.9 μm long, contents usually one well-defined, central globule. *Basidia* 23-30 × (9.4) 10.5-11.7 (12.9) μm, broadly clavate, often flattened distally, mostly 4-sterigmate but rarely with 2-3 sterigmata, hyaline to rarely pale golden in KOH with granular and occasionaly globular contents, granular contents occasionally pseudoamyloid. *Hymenopodium* palisadic; basidioles hyaline to pale yellow in KOH, weakly pseudoamyloid. *Pleurocystidia* (23.4) 27-40 (42.1) μm × (5.9) 7-11.7 μm, ventricose-rostrate, occasionally mucronate and rarely sublanceolate, infrequent, hardly projecting above hymenopodium, hyaline to pale yellow with granular contents and minute incrustations in KOH, internal bodies occasionally pseudoamyloid. *Cheilocystidia* on tube edges more frequent, identical to pleurocystidia. *Hymenophoral trama* boletoid; lateral hyphae moderately divergent from mediostratum; lateral hyphae 2-5 μm wide, hyaline in KOH, gelatinized and separating in KOH; mediostratum 29-43 μm wide, pale yellow in KOH, gelatinized, hyphae indistinct; conducting hyphae absent. *Pileus surface* a trichodermium of long, uninflated filiform elements; hyphae 7--14 μm wide, usually fascicled, largely anticlinal but occasionally repent, light to dark ochraceous in KOH, in Melzer's weakly pseudoamyloid and with fine incrustations visible; tips broadly rounded to rarely acuminate to subcapitate; hypodermium undifferentiated, concolorous. *Pileus trama* interwoven, individual hyphae 3-4 μm wide, hyaline in KOH, conducting hyphae absent. *Stipe surface* an erect, shallow trichodermium of uninflated filiform elements; hyphae 3-5.5 μm wide, fascicled, ochraceous in KOH with minute incrustations visible, with pseudoamyloid internal bodies; terminal cells 30-50 μm long, occasionally projecting to 70 μm; caulocystidia absent. *Clamp connections* absent.

Macrochemical reactions. NH_4OH on surface of pileus and stipe bright blue immediately, eventually fading; KOH on pileus surface dull greenish blue immediately.

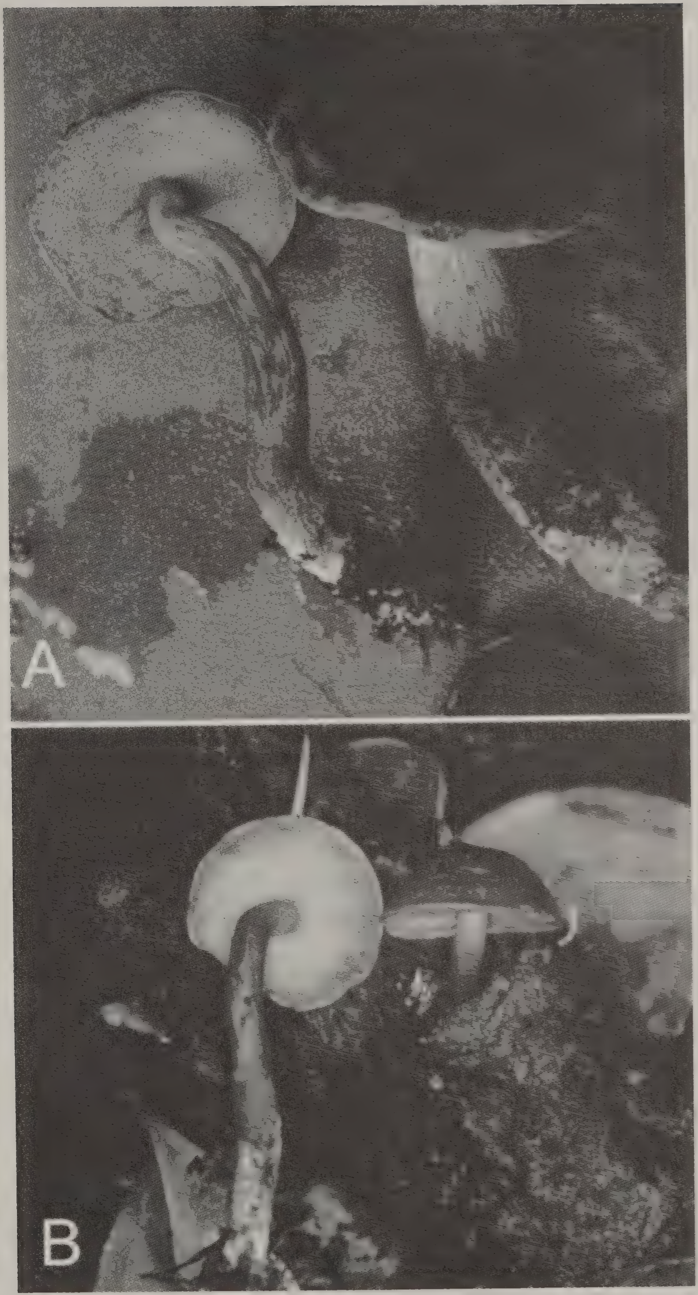
Etymology. The Pakaraima Mountains of western Guyana constitute the type locality for the species.

Habit, habitat, and distribution. Solitary to occasionally scattered and infrequent on root mat and well-rotted woody debris of forests heavily dominated by *Dicymbe corymbosa* Spruce ex Benth. and *Dicymbe altsonii* Sandw., also in association with *Dicymbe jenmanii* Sandw., in montane foothills, 700-1100 m elevation; fruiting during the heavy rainy season of May-July and also during wet interludes of other months; known only from the Upper Ireng River and Upper Potaro River watersheds in the Pakaraima Mountains of western Guyana.

HOLOTYPE. GUYANA. REGION 8, POTARO-SIPARUNI: Pakaraima Mountains, Upper Ireng River watershed, Mt. Kukuinang, fringing forest at western edge of savanna, 2 km southwest of summit, elevation 1100 m, under *D. jenmanii*, 25 May, 1998, *Henkel 6610* (BRG; ISOTYPE: DUKE).

Specimens examined. GUYANA. REGION 8, POTARO-SIPARUNI. Pakaraima Mountains: east bank of Upper Ireng River, 0.75 km downstream from Kurutuik Falls, elevation 700 m, ridge forest dominated by *D. corymbosa*, 14 February 1997, *Henkel 6222* (BRG, DUKE); Upper Ireng

Fig. 1. Basidiomata of *Tylopilus pakaraimensis*. A. *Henkel 6610* (Holotype; × 0.75). B. *Henkel 6553* (× 0.6).


A
B

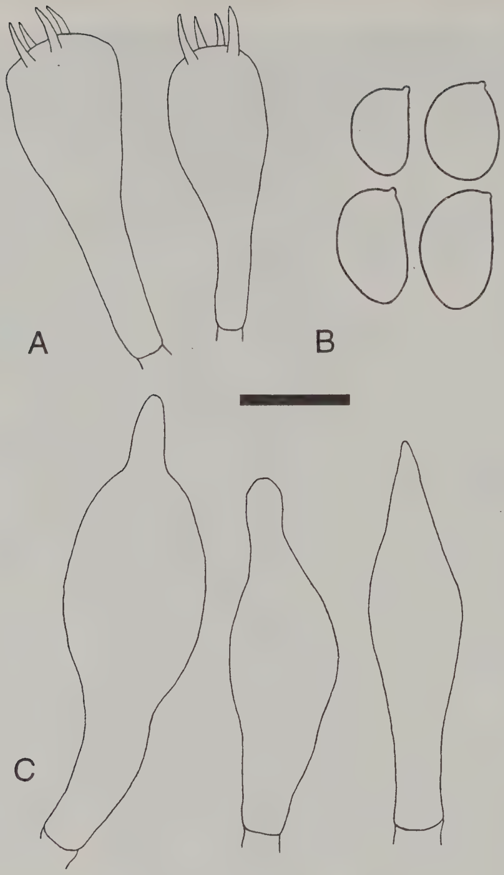


Fig. 2. Microscopic features of *Tylopilus pakaraimensis* (Holotype). A. Basidia. B. Basidiospores. C. Pleurocystidia. Scale bar = 10 μm.

River watershed, west bank of Suruwabaru Creek, 1 km upstream from juncture with Yuarka Creek, elevation 750 m, under *D. altsonii*, 3 March 1997, *Henkel 6290* (BRG, DUKE); east bank of Upper Ireng River, 1 km downstream from Kurutuik Falls, slope forest dominated by *D. corymbosa*, elevation 710 m, 15 May 1998, *Henkel 6405* (BRG, DUKE); Upper Ireng River watershed, east bank of Sukabi River, 1.5 km upstream from confluence with Ireng River, elevation 710 m, slope forest dominated by *D. corymbosa*, 22 May 1998, *Henkel 6444* (BRG, DUKE); Upper Ireng River watershed, toe slopes of Mt. Kukuinang, 2.5 km east of confluence of Sukabi and Ireng Rivers, elevation 900 m, under *D. corymbosa*, 23 May 1998, *Henkel 6553* (BRG, DUKE); Upper Ireng River watershed, Mt. Kukuinang, fringing forest at western edge of savanna, 2 km southwest of summit, elevation 1100 m, under *D. jenmanii*, 25 May 1998, *Henkel 6610* (HOLOTYPE: BRG; ISOTYPE: DUKE); Upper Ireng River watershed, east bank of Suruwabaru Creek, 1 km upstream from juncture with Yuarka Creek, elevation 750 m, under *D. corymbosa*, 28 May 1999, *Henkel 7077* (BRG, DUKE); north bank of Upper Potaro River, 0.5 km west of Ayanganna airstrip, in sheet-rock forest under *D. corymbosa*, elevation 750 m, 19 May 2000, *Henkel 7406* (BRG, DUKE); Upper Potaro River, slope forest along south bank, 1 km east of confluence with Kobodongbaru Creek, elevation 780 m, under *D. corymbosa*, 23 June 2000, *Henkel 7543* (BRG, DUKE); Upper Potaro River, slope forest 4 km east of confluence with Alukyawongbaru Creek, elevation 750 m, under *D. corymbosa*, 24 July 2000, *Henkel 7882* (BRG, DUKE).

Additional specimens examined. GUYANA. REGION 8, POTARO-SIPARUNI. *Tylopilus potamogeton* Singer var. *irengensis* Henkel, Upper Ireng River watershed, east bank of Suruwabaru Creek, 1-2 km upstream from juncture with Yuarka Creek, under *D. corymbosa*, 2 March 1997, *Henkel 6266* (ISOTYPE of variety, DUKE). BRAZIL. AMAZONAS: *Tylopilus potamogeton* var. *aquarius* Singer, Igarape do Tarumazihno, 19 March 1980, *Singer 12052* (HOLOTYPE of variety, F).

Commentary. *Tylopilus pakaraimensis* is a beautiful bolete recognized in the field by the combination of lilac to nearly violet pileus surface, lilac pore surface staining tan upon pressure, the brown, sub-equal stipe often with a true reticulum and whitish basal mycelium, and the bitter taste. Bluing of the pileus surface with ammonia is easily checked in the field, as is the rich golden yellow color of the lower stipe trama. Basidiomata of this species, though infrequent, appeared consistently throughout the May July rainy seasons of 1997-2000, and can be found during wet interludes of drier months (Henkel pers. obs.). As far as is currently known, *T. pakaraimensis* is associated exclusively with *Dicymbe corymbosa*, *D. altsonii*, and *D. jenmanii*, although other ectotrophic tree species are known to occur in the region (e.g. *Aldina insignis* (Benth.) Endl., Papilionaceae). In the case of *D. corymbosa*, direct mycelial connections between basidiomata of *T. pakaraimensis* and ectomycorrhizal rootlets of the tree have been observed by the author.

Tylopilus pakaraimensis fits Singer's definition of *Tylopilus* section *Potamogetones* due to the unique combination, for *Tylopilus*, of broad, short spores (Q = 1.5-1.8) with the strong bluing reaction of the pileus and stipe surfaces with ammonia (Singer 1978, 1986). Although the blue ammonia reaction occurs in at least two other tropical *Tylopilus* species, *T. arenarius* Singer from the Brazilian Amazon, and *T. beelii* Heinemann et Goos. from the Congo, neither of these species have the short, low-Q spores and have been placed in other sections of the genus (Heinemann 1954, Singer 1978, 1986). Currently, *Tylopilus* section *Potamogetones* appears endemic to ectotrophic forests of the greater Amazonian region, with *T. pakaraimensis* joining the the three other known taxa of the section: *T. potamogeton* Singer var. *potamogeton* Singer and *T. potamogeton* var. *aquarius* Singer from central Brazil, and *T. potamogeton* var. *irengensis* Henkel from western Guyana (Singer et al. 1983, Henkel 1999). *Tylopilus pakaraimensis* is phenotypically allied with the varieties of *T. potamogeton* in terms of pileipellis configuration, spore dimensions, and the ammonia bluing reaction. *Tylopilus pakaraimensis* and the sympatric *T. potamogeton* var. *irengensis* are diagnostically similar due to their consistently large basidiomata, the presence of yellow trama in the lower stipe, and the pronounced bruising reaction of the hymenophore. These characters are not present in the Brazilian varieties of *T. potamogeton*. Both *T. pakaraimensis* and *T. potamogeton* var. *irengensis* lack the abundant, large yellow conducting hyphae present in the tube trama of the type collection of *T. potamogeton* var. *aquarius*, though these conducting hyphae were not mentioned in the original description of this variety (Singer et al. 1983).

Significant macroscopic features of *T. pakaraimensis* which contrast this species with *T. potamogeton* var. *irengensis* include the presence, in *T. pakaraimensis*, of lilac to violet colors of the pileus and tube mouths, the development of a true reticulum on the upper stipe, and a more consistent and stronger blue auto-oxidation reaction of the pileus trama upon exposure. Microscopically *T. pakaraimensis* diverges from *T. potamogeton* var. *irengensis* in its possession of shorter spores (8.2-9.9 μm vs. 9-12 μm) with shorter hilar appendices (0.5-0.9 μm vs. 1-1.5 μm) and consistently longer pleurocystidia (27-40 μm vs. 20-28 μm). In addition, the stipe trichodermium of *T. pakaraimensis* is composed of erect, fascicled filiform elements as opposed to the largely repent, interwoven stipitipellis hyphae of *T. potamogeton* var. *irengensis*.

The current disposition of *T. pakaraimensis* in section *Potamogetones* is advised due to the characteristic low-Q value of the spores and the ammonia bluing reaction. This combination of characters is not known to occur in *Tylopilus* species from North America (Snell and Dick 1970, Smith and Thiers 1971, Baroni pers. comm.), Central America (Singer et al. 1991, Halling pers. comm.), Southeast Asia (Corner 1972), or Congolian Africa (Heinemann 1954). Problems do exist, however, with the assignment of *T. pakaraimensis* to section *Potamogetones*. The presence of a true stipe reticulum, as exhibited by numerous other species consigned to other sections of *Tylopilus* (Singer 1986), has not been previously reported for taxa in section *Potamogetones*. Additionally, both *T. pakaraimensis* and *T. potamogeton* var. *irengensis* exhibit a distinct auto-oxidation of the bruised hymenophore, a feature previously considered to be restricted to *Tylopilus* section *Oxydabiles* (Singer 1986). Divergences from traditional generic and infrageneric characterizations of Boletaceae are frequently encountered in tropical taxa (Corner 1972, Henkel 1999). Continued exploration of the poorly-collected tropical bolete mycota, with additional input from molecular phylogenetics, are needed for the eventual reassessment of bolete taxonomy.

Key to taxa of *Tylopilus* section *Potamogetones*

1. Context white, bluing slightly to moderately; lower stipe trama yellow initially; pileus reaching 100 mm broad.

    2. Pileus and tube mouths lilac to violet; reticulum of upper stipe distinct, or occasionally none; spores 8.2-9.9 × 5-5.9 µm………… ……………………………………..…………….*T. pakaraimensis*

    2. Pileus flesh-colored; stipe reticulum absent; spores 9-12 × 4.8-6.4 µm ……………………………………*T. potamogeton* var. *irengensis*

1. Context white, unchanging; pileus reaching 40 mm broad.

    3. NH_4OH on pileus and stipe bright blue; stipe tomentose at base, thinly fibrillose to glabrescent above; spores 9-11.5 × 5.5-7.5 µm… ………………………………………*T. potamogeton* var. *aquarius*

    3. NH_4OH on pileus and stipe brown to bluish-black; stipe densely tomentose at base and fibrillose above; spores 9-12 × 6-8 µm…….. ………………………………….....*T. potamogeton* var. *potamogeton*

ACKNOWLEDGEMENTS

This work was supported by grants from the Smithsonian Institution's Biological Diversity of the Guianas Program, the National Geographic Society's Committee for Research and Exploration, the A. W. Mellon Foundation, and the Center for International Studies at Duke University. The author gratefully acknowledges help from Greg Mueller in accessing Rolf Singer's Amazonian collections at the Field Museum of Natural History, Chicago. The author wishes to thank Mark Garland for the Latin diagnosis, and Mimi Chin, Harold Ameer, Regis James, Christopher Andrew, and Leonard Williams for expert field assistance in Guyana. Tim Baroni critically reviewed the manuscript. This paper is number 50 in the Smithsonian Institution's Biological Diversity of the Guianas publication series.

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MYCOTAXON
Volume LXXVIII, pp. 115-125 April-June 2001

ENTOMOGENOUS CORDYCEPS AND RELATED GENERA FROM MEXICO WITH DISCUSSIONS ON THEIR HOSTS AND NEW RECORDS

by

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Abstract

Fifteen species of *Cordyceps* (Ascomycotina, Hypocreales, Clavicipitaceae) and related genera and their anamorphs parasitic on insects have been recorded from Mexico, of which *Cordyceps dipterigena* (from the State of Veracruz in a subtropical humid forest on flies of the genus *Eucalliphora*) and *C. pruinosa* (from Quintana Roo in a tropical rain forest on an unknown host) are first reported for the country. *Cordyceps militaris* presents the broadest distribution in the country. The confusion between *C. gracilis* and *C. entomorrhiza* is discussed. *Cordyceps melolonthae* var. *rickii* only previously known from Chiapas, is now reported from two new localities in Chiapas, and from the States of Oaxaca and Veracruz; in Oaxaca and Chiapas on larvae of *Enema endymion*, and in Veracruz on larvae of *Strategus aloeus* (both Coleoptera, Melolonthidae, subfam. Dynastinae, tribus Oryctini).

Key words: *Cordyceps dipterigena, C. pruinosa, C. melolonthae* var. *rickii*

Introduction

The first reports of fungi parasitic on insects in Mexico are from the XIX century (Urbina, 1881, and Sánchez, 1886). They described an "animal-planta" (animal-plant) as something rare in nature. Urbina's paper (1881) was a comment in a note from Milne-Edwards about *Sphaeria* (*Torrubia*) *sobolifera* (a synonym of *Cordyceps sobolifera*, see Table 1) growing on larvae of *Cicada* (Homoptera). Sánchez (1886) discussed about the "tlalomites", an indian name for insect larvae eaten by the Aztecs parasited by fungi. The fungus reported by Sánchez (1886) was identified by Pérez-Silva (1979) as *Isaria cosmopsaltria*. However, since both fungi illustrated by Sánchez (1886) and Pérez-Silva (1979) are infecting a scarab adult (Coleoptera), and not a tlalomite, then it seems that *I. cosmopsaltria* is an independent fungus of tlalomite larvae. Petch (1933-1934) commented in the discussion of *Cordyceps sobolifera* that the numerous specimens of *Isaria sinclairii* (the anamorph of *Cordyceps sobolifera*) from Mexico at the British Museum are known locally as "chicharra" or "animal-planta". Obviously, there is a mistake in the information, since "chicharra" is the common name of the cicadas. Probably these Mexican specimens were sent to England by Urbina according to his report (Urbina, 1881). Modern reports on *Cordyceps* from Mexico and related genera and its anamorphs are those of Pérez-Silva (1977, 1978, 1979), Blackwell and Gilbertson (1981, 1984), Ulloa and Benavides (1991), Rodríguez *et al.* (1993) and Rubio-Bustos *et al.* (1999). In this paper a bibliography and herbarium revision of the Mexican species of the group is presented. *Cordyceps melolonthae* var. *rickii* is first recorded from Oaxaca and Veracruz, and from two new localities in Chiapas, and two species of *Cordyceps* are reported as new from Mexico.

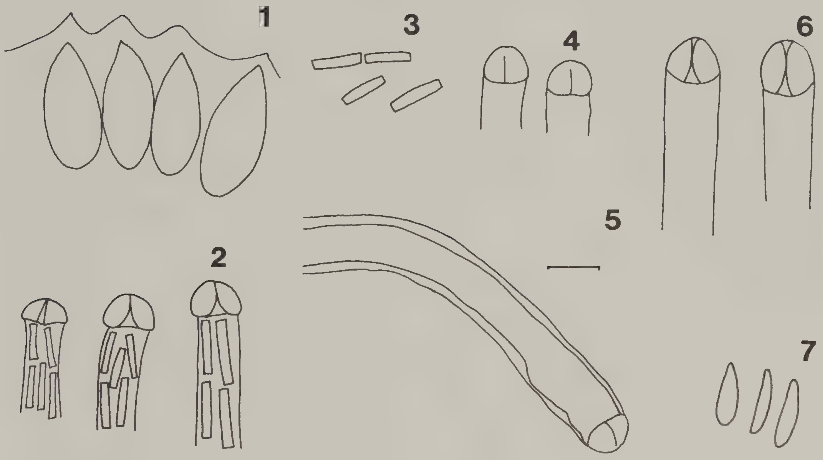
Materials and methods

The specimens studied were observed by light microscopy with the fungi mounted in KOH 5% and in Congo Red. The majority of the herbarium material is in XAL as dried specimens, but two specimens are in alcohol in the Entomological Collection of the Institute of Ecology (IE) at Xalapa, Veracruz.

The known entomogenous *Cordyceps* and related genera including their anamorph stages from Mexico

According to revisions of ascomycetes from Mexico (Chacón and Guzmán, 1983, García-Romero *et al.*, 1970, Medel *et al.*, 1999), and the reports of Blackwell & Gilbertson (1981, 1984), Díaz-Barriga *et al.* (1988), Duges (1924), Guzmán (1977), Mains (1951, 1955, 1958, 1959), Pérez-Silva (1977, 1978, 1979), Rodríguez *et al.* (1993), Rubio-Bustos *et al.* (1999) and Ulloa and Benavides (1991), there are fifteen species of *Cordyceps* and related genera and its anamorph stages in Mexico. These latter belong to the genera *Aschersonia, Cordycepioideus, Hirsutella, Hymenostilbe, Isaria, Paecilomyces* and *Paraisaria* (Table 1). The oldest references are those of Urbina (1881), Sánchez (1886) and Petch (1933-1934) as previously discussed.

Of the known entomogenous *Cordyceps* species, *C. militaris,* distinguished by its cylindric and orange-red stromata with a finely roughened surface at the apex, as was observed in several specimens at XAL and IBUG (Fig. 11), has the broadest distribution through ten states of the country (Chiapas, Hidalgo, Jalisco, Michoacán, Morelos, Nuevo León, Oaxaca, Sinaloa, State of Mexico and Veracruz) (see Table 1). However, *C. sobolifera*, only known from Coahuila, Guanajuato and Jalisco, is the species most recorded, in nine references as against seven for *C. militaris*. *Cordyceps entomorrhiza* in Mexico was only reported from the State of Veracruz (Pérez-Silva, 1978; Chacón & Guzmán, 1983, 1995; Chacón *et al.*, 1995; Rubio-Bustos *et al.*, 1999). This species is very close to *C. gracilis* (Fig. 12), with which it has been confused previously as pointed out



Figs. 1-7.- *Cordyceps melolonthae* var. *rickii* and *Cordyceps dipterigena*. 1-5: *C. melolonthae* var. *rickii*, 1: Perithecia, 2:Asci, 3: Secundary ascospores, 4: Caps of the asci, 5: An asci without ascospores. 6-7: *C. dipterigena*, 6: Caps of the asci, 7: Secundary ascospores (1-5: *Wolf 2559-1*; 5: *Robles*; 6-7: *Ramírez-Guillén 15*). Scale bar: 1= 160 μm; 2-7 = 6 μm.

by Petch (1933-1934), Mains (1951) and Brady (1984). *Cordyceps gracilis* according to Mains (1951, 1958), Eckblad (1967), Smith & Smith (1973), Dennis (1978), Brady (1984), Allard (1998) and Zang & Kinjo (1998), has globose red, orange or ochraceous heads, with numerous dark perithecial ostioles on the surface. The perithecia are completely embedded, and the stipe is yellow or yellowish, in contrast to *C. entomorrhiza* which has globose light vinaceous drab, violaceous gray or brown grayish heads, with a verrucose surface due to the projecting perithecia; the stipe being pallid brownish above to deep brown below. *Cordyceps gracilis* is most common on larvae of Lepidoptera and probably restricted to this order, while *C. entomorrhiza* is probably specific to beetle larvae. Revising the collections of "*C. entomorrhiza*" at XAL, including those reported by Chacón and Guzmán (1983, 1995), Chacón *et al.* (1995) and Rubio-Bustos *et al.* (1999), all of them from Veracruz agree well with the concept of *C. gracilis* as discussed above. The material of *C. entomorrhiza* reported by Pérez-Silva (1978) and illustrated (Fig. 2, page 20) cleary belongs to *C. entomorrhiza*, but she described dark red heads and a brownish stipe for the stromata, which is more typical of *C. gracilis*. Rubio-Bustos *et al.* (1999) considered *C. entomorrhiza* to have brownish-orange or reddish heads, and a brownish stipe. They based their descriptions on the collections at XAL. *Cordyceps gracilis* reported by Rubio-Bustos *et al.* (1999) from Jalisco was based on the specimens: *Álvarez 45, Brown 182, Gutiérrez-Torres 14, Guzmán-Dávalos 4857* and *Vázquez 127*, which were studied in present work; these agree well with the species concept. It is concluded that *C. entomorrhiza* has been confused with *C. gracilis* in Mexico but that *C. gracilis* is a common entomogenous fungus on Lepidoptera, known from Veracruz and Jalisco. It is recorded here from three new localities in Veracruz, based on the XAL specimens: 1) Xico Municipio, Cofre de Perote Region, Los Gallos, *Bandala 661*; 2) Banderilla Municipio, Cerro La Martinica, *Guzmán 12458*; and 3) Xalapa Municipio, Rio Coapexpan, *Bandala 1357*. The anamorph of *C. gracilis* according to Brady (1984) is *Paraisaria dubia* (Table 1). It is interesting to observe that of the known localities of *C. gracilis* in Veracruz, the Botanical Garden at IE, presents the highest number of specimens. Chacón and Guzmán (1995) reported 57 collections between 1987 and 1990. Of the 10 species of fungi studied by Chacón and Guzmán (1995) in the Botanical Garden, "*Cordyceps entomorrhiza*" was the most common (57 collections again 31-49 the others). From 1991 to the present, however, only a few records of *C. gracilis* have been found, in spite of the frequent mycological explorations in this locality. Allard (1998) found in France a new record of *C. gracilis* after 30 years of the last in the same place.

There is another species of *Cordyceps* recorded in the Botanical Garden at Xalapa, this is *C. dipterigena* (Table 1), a new record for Mexico. This fungus is parasitic on flies probably of the genus *Eucalliphora* (Diptera, Calliphoridae), which are parasites of larvae of Lepidoptera. The stromata are cinnamon orange or cinnamon brown, with the heads around 1-2.5 mm wide, hemisphaerical or subgloboid. The asci are delicate, hyaline, more than 320 μm long, by 6-10 μm wide, with prominent hyaline caps, 5-7 x 6-6.5 μm. The ascospores are filiform, multiseptate, breaking up into cylindrical or fusiform-elliptical fragments, hyaline, 6-8 x 1-1.5 μm (Figs. 6-7 & 14-16). Conidial stage not observed. Mains (1958) and Brady (1979) reported *C. dipterigena* from Eastern U.S.A., Costa Rica, Panama, British Guiana, Brazil, Puerto Rico, Trinidad, Sri Lanka, Indonesia, New Guinea, Japan and Ghana. The anamorph of *C. dipterigena* according to Brady (1979) is *Hymenostilbe dipterigena* (Table 1).

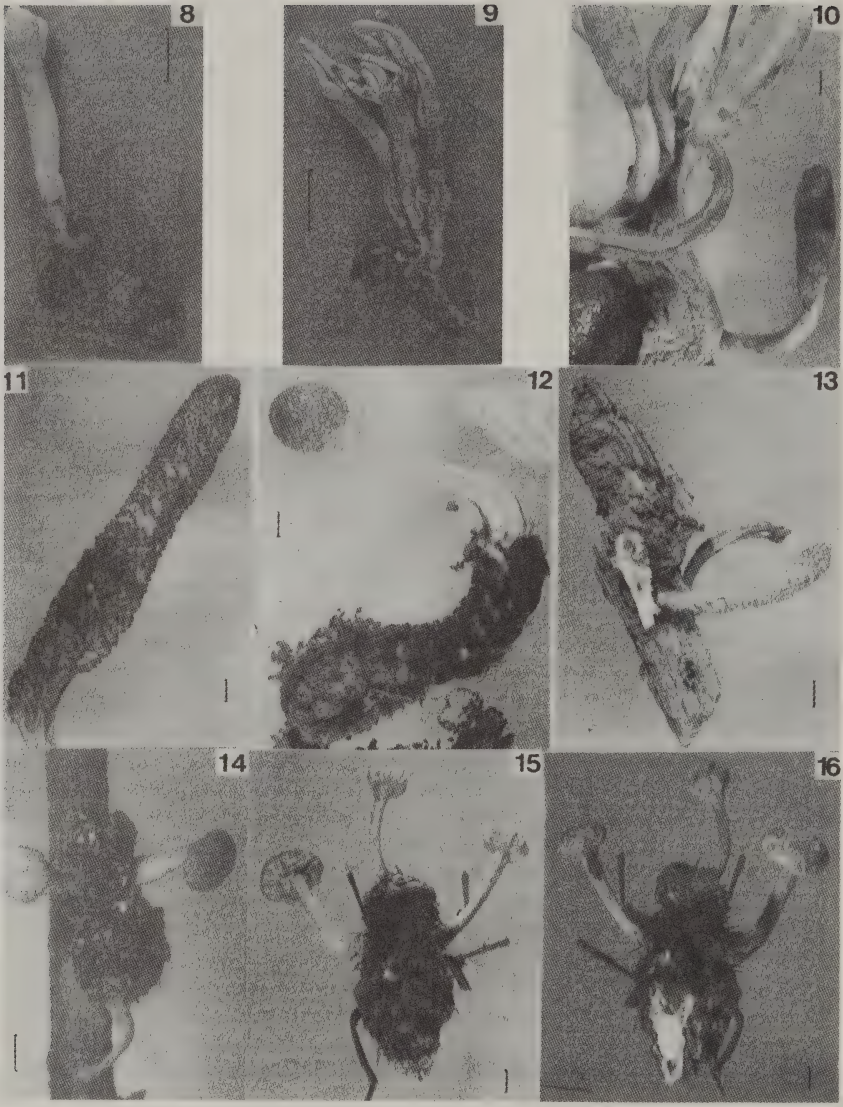
Another new record of a *Cordyceps* from Mexico, is *C. pruinosa* (Table 1), collected in Quintana Roo and deposited in XAL Herbarium (identified by Evans in 1990). The species was previously only known from Asia (Sri Lanka and Japan) and Africa (Congo, today know as Ruanda) (Moureau, 1961) (Table 1). The host of the Mexican specimen is unknown. This species has reddish and roughened stromata (Fig. 13).

New records of *Cordyceps melolonthae* var. *rickii* in Chiapas, Oaxaca and Veracruz

Figs. 1-5 & 8-10

Cordyceps melolonthae var. *rickii* was thus far known in Mexico only from two collections at Tuxtla Gutiérrez, Chiapas (Pérez-Silva, 1977) (at MEXU and at P). They were found on unidentified Coleoptera larvae (Melolonthidae). We are reporting here four new localities from Chiapas, Oaxaca and Veracruz. The specimens studied agree well with Pérez-Silva (1977) and Mains (1958). The latter reported the fungus from Nicaragua, Brazil, Guyana and probably from Ecuador. The var. *melolonthae* ocurrs only in the U.S.A. on *Phyllophaga* larvae (Mains, 1958). Evans *et al.* (1999) discussed the fungi parasitic on *Cochliotus melolonthoides* (Gerst.) a Scarabaeidae from Tanzania, misidentified in Sri Lanka as *Cordyceps melolonthae*. They identified the fungus as *Cordyceps barnesii* Thw. These authors following Mains (1958), concluded that *C. melolonthae* is confined to America, of which var. *melolonthae* occurs only on *Phyllophaga* spp. in the U.S.A. and the var. *rickii* on lamellicorn beetles in tropical North and South America. Mains (1957) first considered *C. rickii* as an independent species, and separated it from *C. melolonthae* by the perithecial layer, which completely covers the upper portion of the stroma in the former, in contrast with the latter, where the perithecial layer develops as irregular patches. Evans *et al.* (1999) illustrated *C. melolonthae* var. *rickii* on a melolonthid larvae buried in forest soil in Amazonian Ecuador, that agrees well with the specimens studied here. Lloyd (1920) described *C. rickii* Lloyd from Brazil, based on a collection by Rick, "growing from the head of some larva", with subcylindric or globose stromata, about 20 mm long, yellow, but with the added observation that they were probably orange when fresh. According to Evans *et al.* (1999), one of the differences between *C. barnesii* and *C. melolonthae* var. *rickii* is the color of the stroma, drab orange to ginger-brown in the former and conspicous sulphur-yellow to yellow-brown in the latter. In addition, the part-spores are larger in *C. barnesii*, 9.4 x 2 µm, and only 4.8 x 1.5 µm in *C. melolonthae* (Evans *et al.*, 1999). Mains (1958) described the 1-celled fragment spores, 4-8 x 1-1.5 µm and the stromata 30-130 x 5-15 mm.

In the dried material, the stromata are 20-58 x 2-5 mm, subcylindric, sulphur-yellow to yellowish-brownish, perithecia brown reddish and stipe pale yellowish, 1-1.5 mm wide, occurring solitary or more commonly gregarious. Perithecia 350-450 x 120-200 µm, yellowish, embedded except for the apices, ovoid with acute apex. Asci 200-220 x 5-5.5 µm, cylindric, with globose caps, 5-6 µm diam. Ascospores filiform, multiseptate, breaking into secondary spores, 1-celled fragments, (4.5-) 5-7 (-8) (-10.5) x 1-1.5 (-2) µm, pale olivaceous and thin walled. The microscopic features were observed in the specimens from Oaxaca. The specimen from Veracruz is immature, without asci, and the specimen from Chiapas is conserved in alcohol and has empty asci.



Figs. 8-16.- *Cordyceps melolonthae* var. *rickii*, *C. militaris*, *C. gracilis*, *C. pruinosa*, and *C. dipterigena*. 8-10: *C. melolonthae* var. *rickii*. 8 & 10: Stroma on a larva of *Enema endymion*, 9: Stroma on a larva of *Strategus aloeus*. 11: *C. militaris*, head of the stroma. 12: *C. gracilis*, a stroma on a larva of Lepidoptera. 13: *C. pruinosa*, a stroma growing on a unknown host within wood. 14-16: *C. dipterigena*, three stromata on flies of the genus *Eucalliphora* (8: *Robles s.n.*; 9: *Chacón 4001*; 10: Wolf 2259-1; 11: *Villarreal, s.n.*. IBUG 815; 12: *Brown 182*; 13: *Guzmán 20626*; 14: *Jarvio 456*; 15-16: *Ramírez-Guillén 15*). Scale bar = 1 cm.

Habitat. The material from Chiapas and Oaxaca is on larvae of *Enema endymion* Chevrolat (Coleoptera, Melolonthidae, subfam. Dynastinae, tribus Oryctini). That from Oaxaca was buried c.5 cm in the soil, in a subtropical humid forest (mesophytic forest), with *Calophyllum, Tapirira, Laplacea, Terminalia, Mosquitoxylum, Vochysia, Enterolobium, Quercus, Podocarpus* and scattered *Pinus chiapensis* (Mart.) Andersen. The material from Veracruz was found on larvae of *Strategus aloeus* (L.), also belonging to the tribe Oryctini, in a disturbed tropical evergreen forest and in a subdeciduous tropical forest. The specimens from Chiapas were found in a coffee plantation where the host *Enema endymion* is a scarab root pest, 32-36 mm long, common in tropical regions of Mexico through Brazil and Bolivia. In Mexico it is known from the States of Campeche, Chiapas, Hidalgo, Oaxaca (Chiltepec, Ixtepec, Santo Domingo, Tuxtepec and Valle Nacional), Puebla, Quintana Roo, Tabasco, Tamaulipas and Veracruz (Morón *et al*. 1997). In Ocozocuautla (Chiapas), one of the authors (MAM) has once observed thousands of flying adults around the light source. The larvae of this beetle may also occur in high densities and large groups of thousand of individuals have been reported as displacing themselves in one direction over the forest floor in Campeche (Mexico) and Guatemala. This insect feeds exclusively on descomposing plant litter. *Strategus aloeus* has also a broad distribution from Mexico to the Amazonian region. Near Villa Las Rosas, Chiapas, a large population of these larvae was observed in seasonaly flooded soil. Nine specimens of *Cordyceps melolonthae* var. *rickii* were collected there.

Material studied. Mexico, State of Chiapas, Tenejapa, Patekton splot, alt. 1600 m, Nov. 1999, *Robles* (in alcohol in the Entomological Collection at the IE). Villa Las Rosas, alt. 1240 m, Oct. 23, 1999, *Alcazar* (in alcohol in the Entomological Collections at IE and ECOSUR at San Cristóbal de las Casas). State of Oaxaca, W of Sierra Madre del Sur, E of Tehuantepec Isthmus, 31 km NE of Lázaro Cárdenas and Escuilapa, road to Santa María Chimalapa (no San Miguel Chimalapa), ca. 9 km from the town, West of Cerro Azul, 16° 51, 45" N, 94° 43, 40" 16°51"W, alt. 400 m, October 27, 1998, *Wolf 2559-1, 2559-2, 2559-3, 2559-4, 2559-5, 2559-6, 2559-7, 2559-8, 2559-9, 2559-10, 2559-11, 2559-12, 2559-13, 2559-14, 2559-15* (all in XAL, except 2559-8, 9 & 13 that are also in the ECOSUR Herbarium, and 2559-2 and 2559-7 that are also in K and NY, respectively). Veracruz, Municipio Catemaco, Ejido López Mateos, alt. 150 m, June 28, 1987, *Chacón 4001* (XAL).

Acknowledgements

The senior author express his thanks to his students Daniel Jarvio and Carlos Cuevas for the *Cordyceps* specimens collected in the Botanical Garden at Xalapa. He also thanks to Rosario Medel, Juan Lara Carmona and María Eugenia Ramírez, from Instituto de Ecología, for their assistance in the preparation of this paper. Laura Guzmán-Dávalos and Olivia Rodríguez, both from the University of Guadalajara, Mexico, helped with information, bibliography and loaned herbarium material. Silvia E. Pérez and José A. Alcazar from ECOSUR, at San Cristóbal, generously donated specimens collected in Chiapas. Vicente Hernández-Ortiz from the Institute of Ecología kindly identificated Diptera specimens. H.C. Evans from CABI-Bioscience, U.K., kindly critically reviewed this paper.

Table 1. Species of entomogenous *Cordyceps* and related genera including their anamorph stages reported from Mexico and new records in XAL Herbarium

Species	Distribution
Aschersonia viridula Sacc. = *A. viridans* (Berk. & M.A. Curtis) Pat.	Veracruz (Mains, 1959).
Cordycepioideus octosporus Blackwell & Gilbn. emend. Blackwell & Gilbn.	Jalisco (Blackwell & Gilbertson, 1981, 1984).
Cordyceps dipterigena Berk. & Broome **anamorph**: *Hymenostilbe dipterigena* Petch	**First record for Mexico**: Veracruz, Botanical Garden of the Instituto de Ecología at Xalapa, a mesophitic forest, Jan. 23, 1997, *Ramírez-Guillén 15*; Jan. 17, 2000, *Jarvio 456* (both in XAL) (Figs. 6-7 & 14-16).
C. entomorrhiza (Dicks. : Fr.) Link sensu Pérez-Silva, 1978	Veracruz (Pérez-Silva, 1978).
C. gracilis Durieu & Mont. = *C. entomorrhiza* sensu Chacón & Guzmán (1983, 1995), Chacón *et al.* (1995) and Rubio-Bustos *et al.* (1999) **anamorph**: *Paraisaria dubia* (Delacr.) Samson & B.L. Brady (= *Isaria dubia* Delacr.)	Jalisco (Medel *et al.*, 1999; Rodríguez *et al.*, 1993; Rubio-Bustos *et al.*, 1999); Veracruz (Chacón & Guzmán, 1983, 1995; Chacón *et al.*, 1995; Rubio-Bustos *et al.*, 2000) (Fig. 12).
C. melolonthae var. *rickii* (Lloyd) Mains	Chiapas and Jalisco (Chacón & Guzmán, 1983; Pérez-Silva, 1977; Rubio-Bustos *et al.*, 1999); Oaxaca and Veracruz (**new records**); without locality (Herrera & Ulloa, 1998) (Figs. 1-5 & 8-10).
C. militaris (Fr.) Link	Chiapas, Jalisco, Nuevo León (in XAL), Hidalgo, Michoacán, Morelos, Oaxaca, Sinaloa, State of Mexico and Veracruz (Chacón & Guzmán, 1984; Díaz-Barriga *et al.*, 1988; Frutis & Guzmán, 1983; Pérez-Silva, 1977; Rubio-Bustos *et al.*, 1999; Welden & Guzmán, 1978); without locality (Guzmán, 1977; Herrera & Ulloa, 1998) (Fig. 11).
C. polyarthra Möller	Jalisco (Rubio-Bustos *et al.*, 1999)

Cont. Table 1.

C. pruinosa Petch	**First record for Mexico**: Quintana Roo, Chunyaxche Zone, near to the road Puerto Morelos to Carrillo Puerto, a tropical rain forest, Nov. 4, 1981, *Guzmán 20626*, XAL; det. H.C. Evans in 1990 (Fig. 13).
C. sobolifera (Berk.) Berk. & Broome = *Sphaeria* (*Torrubia*) *sobolifera* Berk. **anamorph**: *Isaria cicadae* Miq.; = *I. sinclairii* (Berk.) Petch; = *I. cosmopsaltria* Yasuda; = *Paecilomyces cicadae* (Miq.) Samson (Mains, 1958; Samson, 1974; Urbina, 1881).	Coahuila, Guanajuato and Jalisco (Chacón & Guzmán, 1983; Duges, 1924; García-Romero *et al.*, 1970; Guzmán & García-Saucedo, 1973; Mains, 1958; Pérez-Silva, 1979; Rubio-Bustos *et al.*, 1999); without locality (Mains, 1951, 1955, 1958; Pérez-Silva, 1979; Petch, 1933-1934; Urbina, 1881).
C. sphecocephala (Klotzsch) Sacc. non *C. sphecocephala* (Berk.) Sacc.	Jalisco (Chacón & Guzmán, 1983; Pérez-Silva, 1977; Rubio-Bustos *et al.*, 1999).
C. stylophora Berk. & Broome **anamorph** : *Hirsutella stylophora* Mains	Jalisco (Pérez-Silva, 1978, in both stages; Rubio-Bustos *et al.*, 1999); without locality (Herrera & Ulloa, 1998).
Hirsutella saussurei (Cooke) Speare = *Isaria crinita* Lloyd **teleomorph**: *Cordyceps humberti* Robin ex Saussure?	Oaxaca (Ulloa & Benavides, 1991).
H. thompsonii Fisher	without locality (Mier *et al.*, 1989, 1992; Sampedro & Rosas, 1989).
Isaria farinosa Fr. = *Paecilomyces farinosus* (Holm. ex S. F. Gray) Brown & Smith (Samson, 1974)	Morelos and Oaxaca (Pérez-Silva, 1977); without locality (Pérez-Silva, 1979).

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MYCOTAXON

Volume LXXVIII, pp. 127-160 April-June 2001

NOTES ON HYPHOMYCETES. LXXXII. A FURTHER CONTRIBUTION TOWARD A MONOGRAPH OF THE GENUS HAPLOTRICHUM

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ABSTRACT

Twelve further species of *Haplotrichum*; namely *H. album*, *H. chilense*, *H. curtisii*, *H. gracile*, *H. linderi*, *H. ochraceum*, *H. ovalisporium*, *H. ramosissimum*, *H. rubiginosum*, *H. simile*, *H. tomentosum*, and *H. vesiculosum*, are described and illustrated. The hallmark characteristics of the respective taxa are particularized, and the generic concept is discussed at greater length, especially in relation to the range of morphological variables which serve to distinguish the recognized species. Certain peculiarities which appear to be unique to this anamorph-complex are noted.

KEYWORDS: *Acladium*, *Alysidium*, *Botryobasidium* anamorphs, generic concepts.

INTRODUCTION

In a preceding paper of this series (Partridge *et al.*, 2001a), the currently accepted generic concept of *Haplotrichum* Link : Fries, including the anamorphs upon which the synonymous genera *Acladium* Link and *Alysidium* Kunze were based, was clarified, and new descriptions and illustrations of the type species of these respective genera were provided. All three represent mitosporic states of the basidiomycete genus *Botryobasidium* Donk. As a continuing contribution to our knowledge of this complex, documentation of the characteristics of twelve further taxa, some producing conidia in chains, others not, is presented herein. The teleomorphs of only five of these are known. As noted previously (Partridge *et al.*, 2001b), misapplication of names to collections of *Haplotrichum* species appears to have occurred quite frequently, which makes more adequate description of their distinguishing morphology critical. This is especially the case since even in those whose teleomorph connections have been determined some confusion has occurred between taxa. For example, such species as *H. simile* (Berk.) Hol.-Jech. and *H. rubiginosum* (Fr.) Hol.-Jech. have often been confused. Moreover, the anamorph and teleomorph states of *Botryobasidium* rarely occur together, the former, more often than not, developing independently of the latter. The mitosporic condition is, in fact, encountered much more frequently in nature, which explains why binomials, in some cases, were applied to the anamorphs many years prior to the discovery of their teleomorph connections. This, of course, has historically been the situation in the case of many fungi whose life cycle is interrupted by seasonally-dictated reproductive activity. The interplay between the functions of spreading in space and preservation in time has often resulted in perplexing challenges for taxonomists.

Although the distinctions between species recognized within the genus are subtle and not always readily apparent, each entity possesses one or more hallmark characteristics by which it is delineated. The morphological distance between accepted taxa, although variable and in some cases quite small, is sufficiently constant in each instance to warrant separation. A process of eco-geographical as well as sympatric speciation has, presumably, been operational within this complex. An attempt is made to particularize distinguishing features of the species treated, some of which have not been sufficiently documented hithertofore. Among the more significant morphological variables are patterns of conidiophore branching, degree of differentiation of conidiogenous cells and their placement, peculiarities of conidiophore denticulation, relative wall thicknesses, length of conidial chains where present and extent of interconidial connecting isthmi, and conidium size, shape, color, and ornamentation, together with degree, width, and position of papillae or scars.

As alluded to previously (Partridge *et al.*, 2001a), in light of the fact that there exists a range of overlapping morphological features, the usefulness of an infra-generic subdivision of *Haplotrichum* into subgenera, sections, and subsections, as proposed by Holubová-Jechová (1980b), remains somewhat questionable. Although Langer & Langer (1998) consider this type of taxonomic compartmentalization advantageous for purposes of species determination, its artificiality was, nevertheless, recognized since the sub-categories do not accurately reflect natural affinities and relationships.

Moreover, it has to be said that in an anamorph form-genus of this size, identification is not appreciably aided by what is essentially a rather burdensome elaboration of its systematics. On the contrary, since intergradation of defining morphological peculiarities, in other words a continuum, exists, determination might be more hindered than helped by employment of this subclassification. Some of the problems attendant in allocating species within this scheme are mentioned under the treatments of individual entities herein.

TAXONOMIC PART*

Haplotrichum album (Sumst.) Hol.-Jech., *Česká Mykol.* 30:3, 1976 (Figure 1).

≡ *Oidium album* Sumst., *Mycologia* 6:34, 1914.

Teleomorph: unknown.

Colonies effuse, comparatively thin but with a densely interwoven subiculum, powdery, at first off-white, becoming pale, creamy ochre with age. Mycelium mostly superficial, composed of abundantly branched, septate, tightly interweaving, smooth, hyaline, 5 to 6 µm wide hyphae. Conidiophores semi-macronematous, mononematous, arising as short, lateral branches of the repent, subicular hyphae, more or less erect, mostly simple or occasionally once-branched, usually somewhat bent, smooth, once or twice septate, moderately thick-walled, hyaline, mostly up to 60 µm long, 6 to 8 µm wide. Conidiogenous cells mostly monoblastic, very occasionally biblastic, integrated, determinate, terminal or originating as a single-celled lateral outgrowth, usually inflated distally to give a clavate aspect, bearing one or two broad, shallow, truncate, slightly projecting, unthickened, 2 to 3 µm wide scars, up to 11 µm wide at their greatest diameter. Conidia acropleurogenous, holoblastic, in simple or branched chains, dry, unicellular, smooth, comparatively thin-walled, more or less ellipsoidal, but often somewhat asymmetrical, with one side more convex than the other, occasionally anastomosing, with broad, flat, truncate, very slightly projecting scars, variously oriented depending upon conidial shape, often obliquely positioned towards the flatter surface, hyaline to sub-hyaline, 13-24 X 12-14 µm.

On bark; North America.

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*[Note: nomenclatural and taxonomic synonyms according to Linder (loc. cit.) and Holubová-Jechová (1969, 1976), unless otherwise noted.]

Specimen examined: Bemus Point, Chautauqua County, New York, USA, D.R. Sumstine, 20 July 1913, FH, isotype.

A number of characteristics serve to distinguish *H. album* from other broadly similar species, most notably its relatively tightly interwoven subiculum, its comparatively short conidiophores, and its predominantly monoblastic, club-shaped conidiogenous cells, bearing broad, barely-discernible, shallow projections at the conidiation loci. The lack of distinct denticles is a peculiarity which this species shares with only a few other taxa, such as *H. chilense* (Linder) Hol.-Jech.; the presence of distinctly denticulate conidiophores being a much more common condition within this genus. Likewise, the absence of elongated interconidial isthmi is a feature which is comparatively rare among catenate *Haplotrichum* species. This is reflected in the almost entire lack of any conidial papillae. Other aspects by which *H. album* differs from similar taxa include the relatively wide, thin, truncate, often slightly obliquely oriented conidial scars and the often asymmetrical shape of conidia occupying an intercalary chain position. An additional feature of note is the occurrence of anastomoses between proximally-produced conidia.

This species was classified by Holubová-Jechová (1980b) in her section *Catenulata* along with *H. dubium* (Pers.) W.A. Baker & Partridge [as *H. aureum* (Pers.) Hol.-Jech.]. It should be noted, however, that *H. album*, while sharing characteristics in common with *H. dubium*, also bears some similarity to a number of other species, such as *H. chilense* and *H. ochraceum* (Povah) Hol.-Jech., both of which were placed in section *Haplotrichum*, subsection *Paucidenticulata*. In regard to the morphology of the conidial chains and conidiation loci (lack of well-developed denticles), *H. album* has, however, as much, if not more, in common with *H. chilense* as it does with *H. dubium*. Similarly, the conidial chains of *H. ochraceum* resemble those of *H. dubium* more than they do those of *H. chilense*, despite a difference in pigmentation. By emphasizing conidiophore branching versus other morphological aspects, Holubová-Jechová (1980b) separates entities that otherwise share several significant features in common. Moreover, placing *H. album* in section *Catenulata*, in which conidiophores are said to be more or less irregularly branched along their whole length, seems inappropriate since in this species these structures are notably short and branching is infrequent.

Haplotrichum chilense (Linder) Hol.-Jech., *Česká Mykol.* 30:3, 1976 (Figure 2).

≡ *Oidium chilense* Linder, *Lloydia* 5:196, 1942.

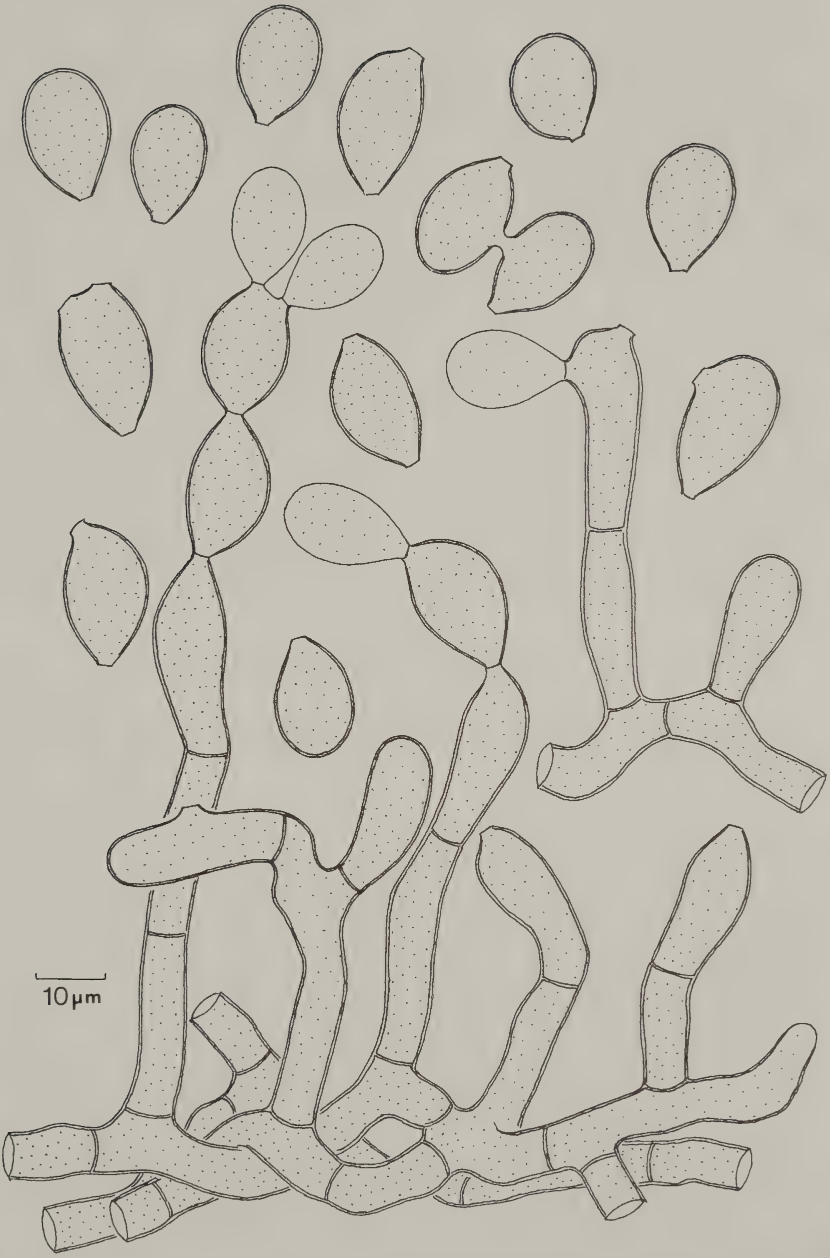

FIGURE 1. *Haplotrichum album*. Conidiophores and conidia.

Teleomorph: *Botryobasidium chilense* Hol.-Jech., *Mycotaxon* 12:117, 1980.

Colonies effuse, sparse, exceedingly thin, loosely lanose, hypochnoid, white to pale ochraceous, becoming somewhat brownish with age. Mycelium mostly superficial, composed of branched, septate, loosely interweaving, occasionally anastomosing, smooth, hyaline, often thick-walled, 1 to 3 µm wide hyphae. Conidiophores semi-macronematous, mononematous, arising laterally or terminally from the repent hyphae, more or less erect, ascending, simple or branched, with branches sometimes originating from the lower third of the main stipe at a wide angle and extending to a similar or slightly greater length, more or less straight to somewhat flexuous, smooth, septate, cylindrical, sometimes somewhat constricted at the septum delimiting the terminal cell, moderately thick-walled, hyaline, up to 250 µm long, 8 to 10 µm wide. Conidiogenous cells mono- or predominantly polyblastic, integrated, determinate, terminal or intercalary, cylindrical or somewhat narrowly clavate, bearing one or more thin, very slightly protuberant, relatively wide conidial scars. Conidia acropleurogenous, holoblastic, usually in short, simple or branched chains, dry, unicellular, smooth, moderately thick-walled, ellipsoid to obovoid, hyaline, 13-16 X 10-11 µm.

On decorticated wood; South America and New Zealand.

Specimen examined: Punta Arenas, Magallanes, Chile, R. Thaxter, March 1906, FH, holotype.

As mentioned above, this species was classified by Holubová-Jechová (1980b) in her section *Haplotrichum*, subsection *Paucidenticulata*, along with *H. ochraceum*, to which it was deemed to be very similar. However, Holubová-Jechová (1980a) refers to *H. chilense* as being a species which is distinguished from *H. capitatum* (Link) Link, on which section *Haplotrichum*, subsection *Multidenticulata*, is based, only with some difficulty. The present authors, in contrast, consider *H. chilense* to be readily distinguishable from both of these two species in several respects. Among these are the lack of well-developed conidiogenous denticles, lesser degree of morphological differentiation, particularly inflation, of the terminal conidiogenous cells, and absence of clearly-defined interconidial isthmi, with consequent absence of conidial papillae. Distally-located conidiogenous cells in *H. chilense* are rather differently-shaped from those of the other two species mentioned, being usually more or less cylindrical and appreciably less vesicular in form. The climax condition in this regard, culminating in, and exemplified by, such species as *H. curtisii* (Berk.) Hol.-Jech., *H. linderi* Hol.-

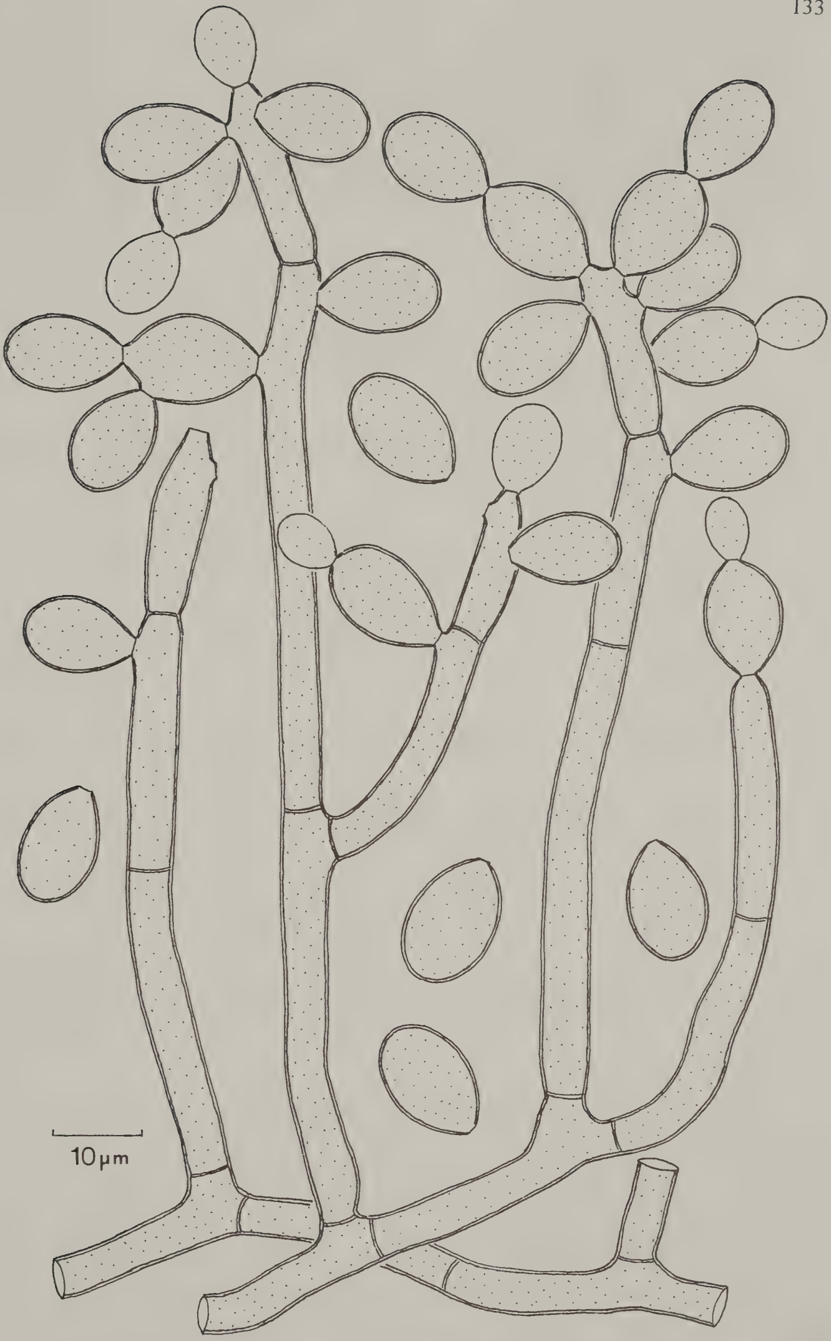

FIGURE 2. *Haplotrichum chilense*. Conidiophores and conidia.

Jech., *H. ramosissimum* (Berk. & M.A. Curtis) Hol-Jech., and *H. rubiginosum*, is seen in rudimentary form in both *H. capitatum* and *H. ochraceum* but not, or hardly at all, in *H. chilense*. In its ultimate development, best seen in *H. vesiculosum* (Linder) Hol.-Jech., the terminal, distinctly vesicular conidiogenous cell takes the form of a disarticulating ramoconidium.

Haplotrichum curtisii (Berk.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 3).

≡ *Aspergillus curtisii* Berk., in Ravenel, Fungi Carolin. Exsic. 4:83, 1855.

≡ *Rhinotrichum curtisii* (Berk.) Berk., in Curtis, Botany of North Carolina, p. 129, 1867.

= *Aspergillus laneus* Schwein., *Syn. Am. Bor.* p. 282, 1832 [non *Aspergillus laneus* Link, 1809].

= *Rhinotrichum globiferum* Berk. & Broome, *Jour. Linn. Soc.* 14:101, 1875.

= *Physospora spiralis* Penz. & Sacc., *Icon. Fung. Javan.* p. 99, 1904.

= *Rhinotrichum sumstinei* Peck, *Bull. Torrey Bot. Club* 34:103, 1907.

= *Rhinotrichum subferruginosum* Sumst., *Mycologia* 3:47, 1911.

= *Hypochnus sub-zygodesmoides* Rick, *Broteria* 3:152, 1934.

Teleomorph: *Botryobasidium curtisii* Hallenb., *Iran. J. Plant Pathol.* 14:48, 1978.

Colonies effuse, spreading, hypochnoid, at first thin and pale, becoming powdery and ochre-orange. Mycelium mostly superficial, composed of branched, septate, interweaving, occasionally anastomosing, smooth, hyaline, 1 to 3 µm wide hyphae. Conidiophores semi-macronematous, mononematous, more or less erect, becoming somewhat prostrate and extensively branched and interweaving when fully developed, branches and sub-branches ascending, mostly straight to somewhat flexuous, cylindrical, smooth, septate, comparatively thinner-walled, denticulate, hyaline, usually up to 450 µm long, 7 to 9 µm in diameter. Conidiogenous cells polyblastic, integrated or discrete as lateral branches, terminal or

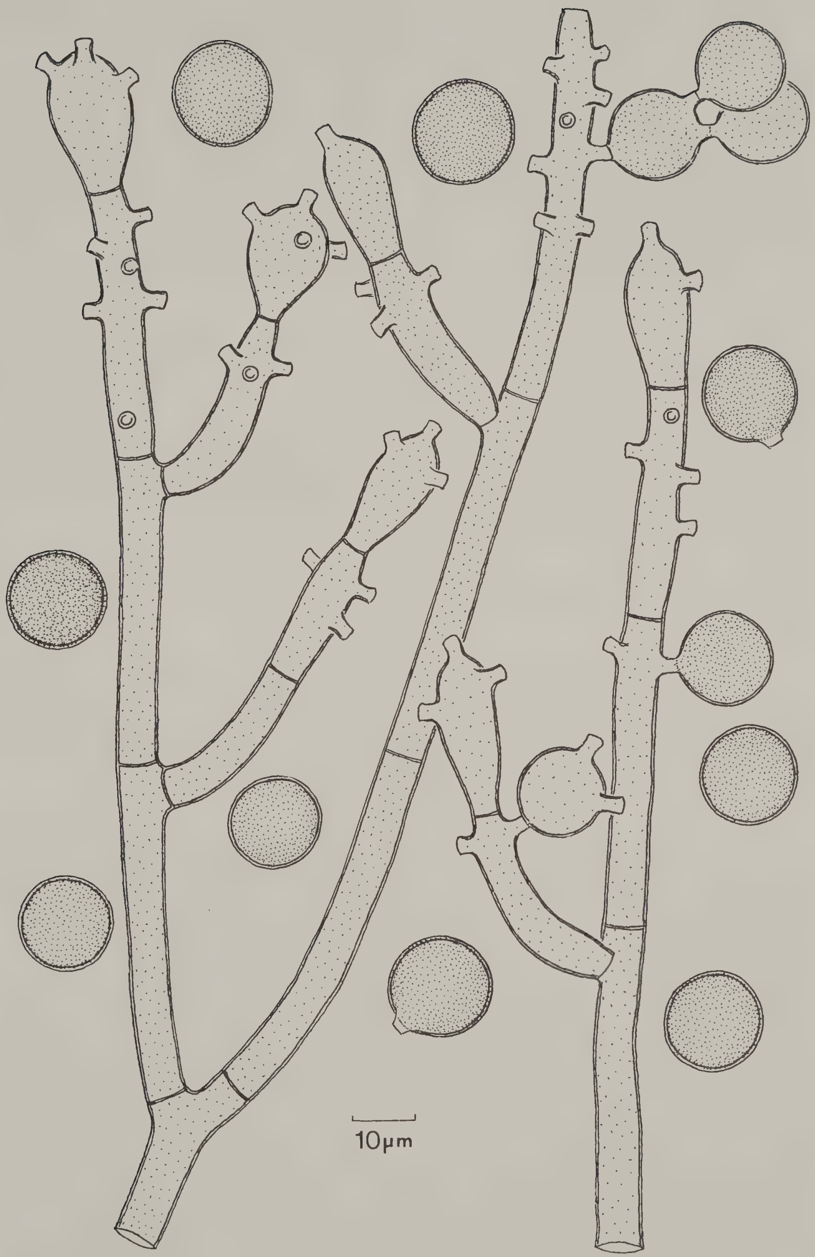

FIGURE 3. *Haplotrichum curtisii*. Conidiophores and conidia.

intercalary, where terminal inflated, becoming broadly clavate to obovoid and vesicle-like, bearing a number of distinct, 3-5 X 2-3 µm denticles at conidiation loci, up to 32 µm long, 7 to 12 µm wide. Terminal conidiogenous cells occasionally disarticulating as conidia, resulting in conidiophores becoming truncate at their distal extreme. Conidia acropleurogenous, holoblastic, solitary or bearing one or two secondary conidia, dry, unicellular, smooth, moderately thick-walled, with the inner wall layer appearing irregular and minutely pitted at maturity, globose, usually bearing a shallow papilla, where ramoconidial with two or more well-developed denticles, sub-hyaline to pale brown, 13-17 X 13-16 µm in size.

On bark or decorticated wood, or spreading over other substrates; North and South America.

Specimen examined: on ground around stump of *Forsythia* sp., Cambridge, Massachusetts, USA, D.H. Linder, 10 July 1941, FH [as *Rhinotrichum curtisii* Berk.].

This species was classified by Holubová-Jechová (1980b) in her section *Vesiculata*, subsection *Ramosa*.

Haplotrichum curtisii can be distinguished from other species having broadly similar characteristics, particularly *H. rubiginosum*, which it closely resembles, by being more loosely branched, by the shape of its conidiogenous cells, lighter pigmentation, and possession of thinner-walled conidia.

The apparently irregular nature of the inner conidial wall layer is a feature which this species shares in common with a number of others, including *H. linderi*, *H. rubiginosum*, *H. simile*, and *H. tomentosum* (Pat.) Hol.-Jech. The precise nature of this structural peculiarity remains, however, obscure and difficult to determine. It has been variously described as a striated or pitted or roughened condition and is more readily discernible in species whose conidia develop relatively thick, deeper pigmented walls. In this connection it should be noted that some discrepancy exists in the literature as to the exact position of this characteristic. Langer (1994) describes conidia of *B. curtisii* as being roughly ornamented and illustrates the external, rather than the internal, surface as such. Hallenberg (1978) had earlier noted the presence of irregular warts on the outer surface and provided a scanning electron micrograph illustrative of this feature. Our observations, however, indicate the outer wall layer in this species to be relatively thin and mostly smooth, at least when viewed under the light microscope, whereas the inner wall layer appears thick and its surface and composition finely uneven, giving the appearance of a ridged or striated condition. Progressive granulation and vacuolation of the cellular contents further exaggerates the uneven complexion of the conidial interior.

During the course of this study, examination of a specimen determined by Dr. D.H. Linder as *Rhinotrichum curtisii* [Coconut Grove, Florida, USA, R. Thaxter, undated, FH] has raised the question of the distinction between *H. curtisii* and the anamorph described by Linder (1942) under the name *Oidium laevisporum* (Cooke) Linder [≡ *Zygodesmus laevisporus* Cooke; ≡ *Rhinotrichum laevisporum* (Cooke) Sumst.]. This particular material closely matches Linder's description of *O. laevisporum* and, moreover, appears to be readily distinguishable from *H. curtisii*. Further consideration will be given to this matter following examination of the type specimen of *Z. laevisporus*. Holubová-Jechová (1969) considered *O. laevisporum* to be a synonym of *H. curtisii* [as *O. curtisii*] but it remains uncertain if these are conspecific. A determination of the appropriate taxonomic status and nomenclatural future for this entity will be made and reported upon in a forthcoming publication.

Haplotrichum gracile (Linder) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 4).

≡ *Oidium gracile* Linder, *Lloydia* 5:195, 1942.

Teleomorph: unknown.

Colonies effuse, spreading, dense, velvety, at first in tufts, eventually becoming confluent and forming a tight mat, cream-colored. Mycelium mostly superficial, composed of branched, septate, closely interweaving, occasionally anastomosing, smooth, hyaline, 1 to 3 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight or somewhat flexuous, usually bearing several arcuate lateral branches, rarely anastomosing, smooth, septate, relatively thin-walled, denticulate, hyaline, up to 1000 µm long, 4.5 to 7 µm wide. Conidiogenous cells polyblastic, integrated, terminal on main stipe or lateral branches, or intercalary in the distal portion, determinate, cylindrical to, more often, narrowly clavate, usually bearing a number of small, cuneiform to spicule-like denticles, 20 to 55 µm long, up to 8 µm wide; denticles generally 2 µm wide basally, 2 µm long. Conidia acropleurogenous, holoblastic, mostly solitary, rarely in chains of two, dry, unicellular, smooth, comparatively thin-walled, ellipsoid to obovate, hyaline, 11-21 X 7-9 µm in size, distinctly papillate at the base.

On decaying wood, bark, and palm rachises; Caribbean and South America.

Specimen examined: on bark, Sao Leopoldo, Rio Grande do Sul, Brazil, J. Rick, 1930, FH, holotype.

This species was classified by Holubová-Jechová (1980b) in her section *Vesiculata*, subsection *Ramosa*. This placement illustrates as well as any other the difficulty of satisfactorily assigning some taxa within the subgeneric categories proposed. *Haplotrichum gracile* forms no appreciably swollen, vesiculose conidiogenous cells comparable to those of *H. ramosissimum*, on which section *Vesiculata* is based, or, for that matter, such other species included in the section as *H. linderi*, *H. rubiginosum*, and *H. vesiculosum*. Although the conidiogenous cells of *H. gracile* are somewhat broader toward their distal end, giving a narrowly clavate aspect, they differ very little in shape from those of *H. conspersum*, upon which section *Avesiculata* is based.

Haplotrichum gracile is significantly different from other species in several respects, most notably in having long conidiophores bearing a number of arcuate branches and sub-branches with terminal, narrowly clavate conidiogenous cells. The presence of small, somewhat pointed denticles, predominantly restricted to terminal and sub-terminal cells, is another distinctive characteristic.

Haplotrichum linderi Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 5).

≡ *Oidium elongatum* Linder, *Lloydia* 5:191, 1942. [*non Haplotrichum elongatum* (Fr.) Bonord., 1851.]

Teleomorph: unknown.

Colonies effuse, spreading, dense, velvety, rust-brown in color. Mycelium mostly superficial, composed of branched, septate, interweaving, anastomosing, smooth, hyaline, 1 to 3 µm wide hyphae. Conidophores semi-macronematous, mononematous, ascending, erect, occasionally branched at wide angles, branches curving sharply upwards and occasionally forming sub-branches of conidiogenous cells, straight to somewhat flexuous, cylindrical, smooth, septate, moderately thick-walled, bearing large, well-developed denticles in the terminal and one or two of the subtending intercalary cells, sub-hyaline to pale brown distally, paler apically, up to 1000 µm long, 5 to 9 µm in diameter. Conidiogenous cells polyblastic, integrated or discrete as

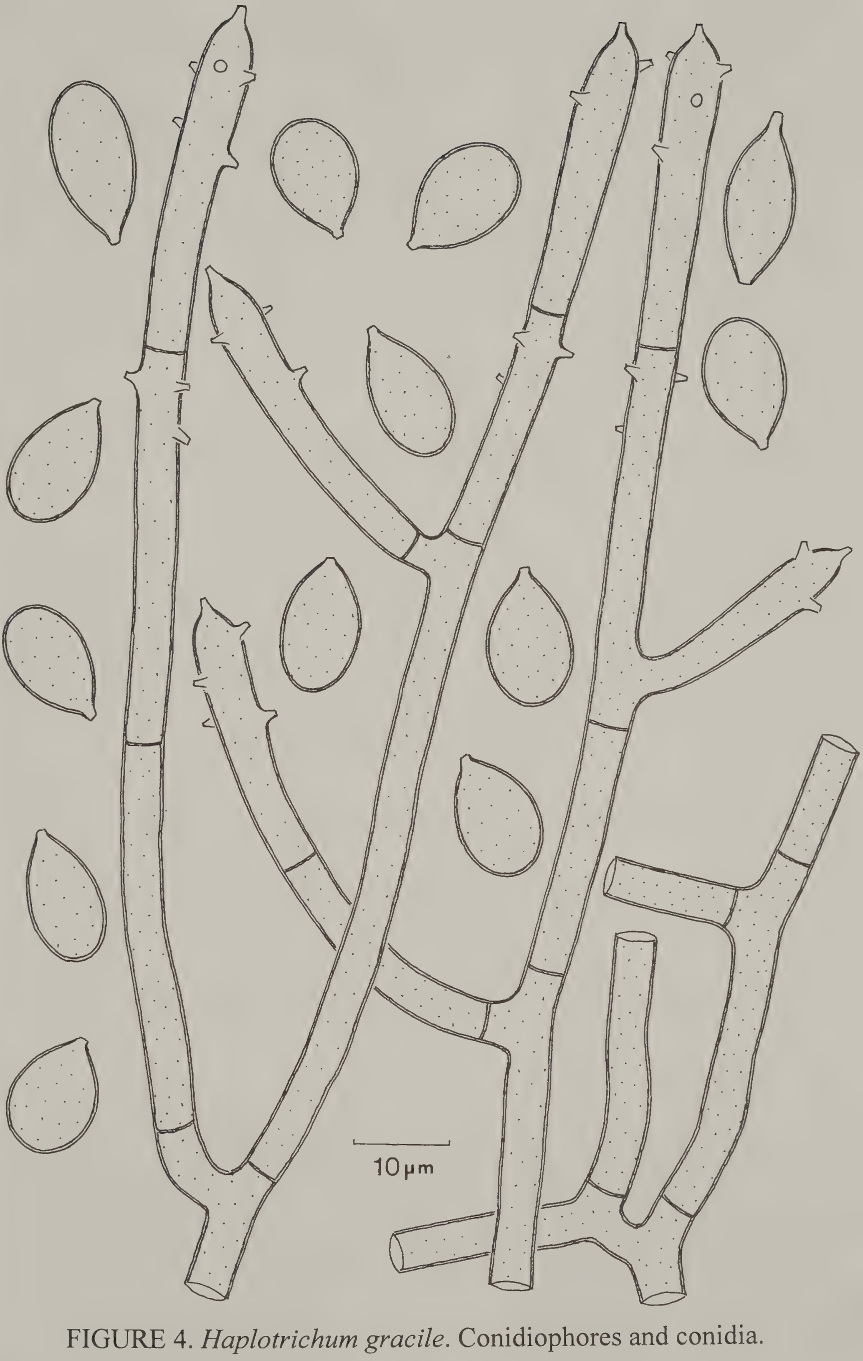

FIGURE 4. *Haplotrichum gracile*. Conidiophores and conidia.

lateral branches, terminal or intercalary, cylindrical or swelling to become clavate to ellipsoid to sub-globose and vesicle-like, bearing one to several distinct, 3-4 X 2-4 µm denticles at conidiation loci, up to 60 µm long, 6 to 10 µm wide. Conidia acropleurogenous, holoblastic, in branched chains of up to three, dry, unicellular, smooth, moderately thick-walled, the internal wall becoming somewhat irregular and minutely pitted, with the conidial contents appearing granulose at maturity, ellipsoid to obovoid and bearing one or two relatively broad, shallow papillae or well-developed denticles, or, where ramoconidial in form, sub-globose with up to four large, distinct denticles, sub-hyaline to mid brown, 15-19 X 10-14 µm in size.

On decomposing wood and bark; North America.

Specimen examined: Cheyenne Mountain, Wyoming, USA, W.C. Sturgis, 27 August 1906, FH, holotype.

This species was classified by Holubová-Jechová (1980b) in her section *Vesiculata*, subsection *Ramosa*. It is readily distinguishable from other taxa classified therein by a combination of conidium shape, size, and pigmentation. Although such other species accommodated in this subsection as *H. gracile*, *H. ramosissimum*, and *H. vesiculosum* have similarly shaped conidia, all three are hyaline. Additionally, possession of extremely long, mostly straight conidiophores is another distinctive characteristic.

Haplotrichum ochraceum (Povah) Hol.-Jech., *Mycotaxon* 12:121, 1980 (Figure 6).

≡ *Monilia ochracea* Povah, *Mich. Acad. Arts, Sci., Letters* 13:181, 1931.

≡ *Oidium ochraceum* (Povah) Linder, *Lloydia* 5:187, 1942.

Teleomorph: unknown.

Colonies widely effuse, ranging from yellow-ochre when young to a deeper apricot hue with age but with the margin usually remaining lighter, at first thin but eventually becoming densely hypochnoid. Mycelium mostly superficial, composed of repent, abundantly branched, septate, loosely interweaving, occasionally anastomosing, smooth, hyaline, 3 to 5.5 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, somewhat flexuous, simple or mostly branched, branches typically oriented at a wide angle relative to the stipe and ascending, smooth,

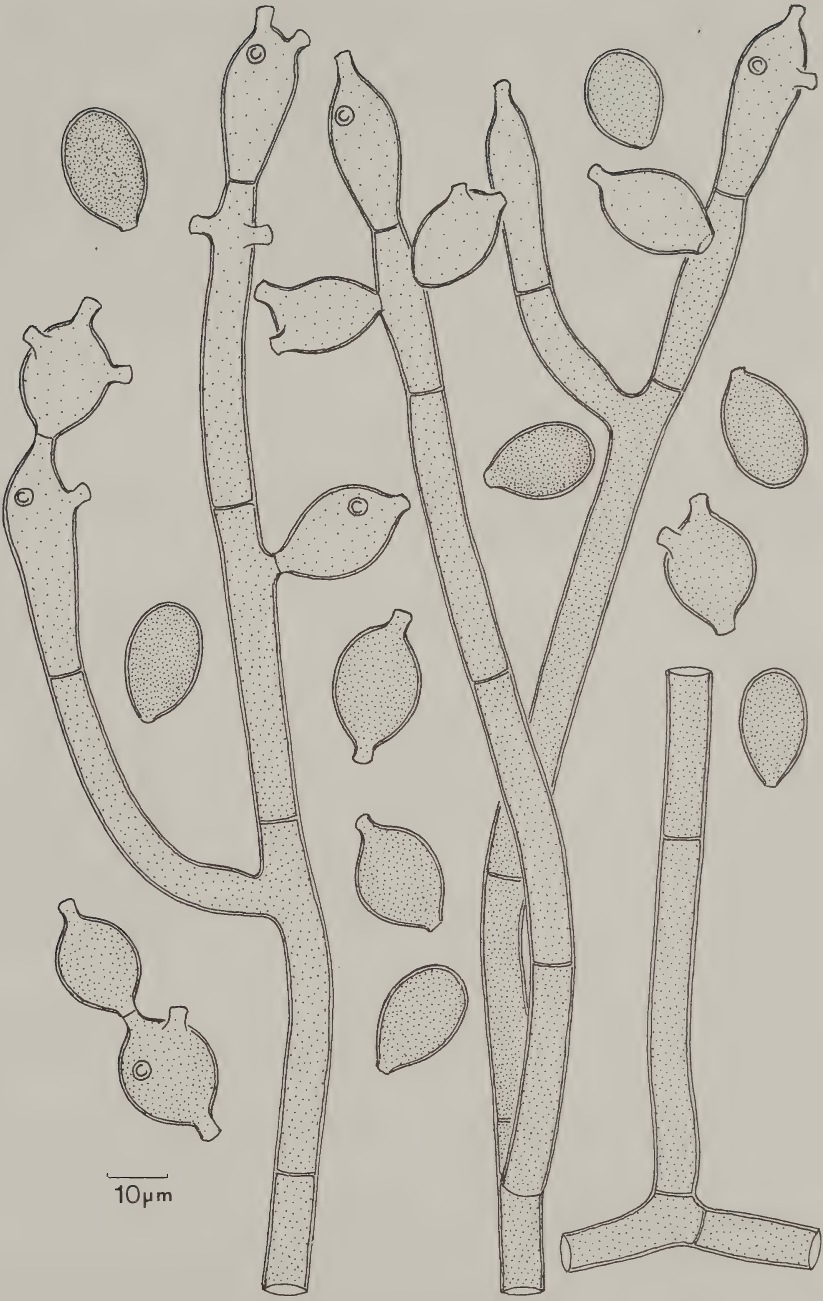

FIGURE 5. *Haplotrichum linderi*. Conidiophores and conidia.

septate, moderately thick-walled, hyaline, up to 320 µm long, but mostly shorter, 5 to 7 µm wide. Conidiogenous cells mono- or predominantly polyblastic, integrated or discrete, determinate, terminal or as lateral extensions, occasionally intercalary, cylindrical or, more frequently, somewhat clavate, when inflated up to 9 µm in diameter, bearing prominent, well-developed denticles. Conidia acropleurogenous, holoblastic, in simple or branched chains, dry, unicellular, smooth, comparatively thinner-walled than in some other species, ellipsoidal to limoniform to broadly fusiform with a distinct papilla at one or both ends, or with two where ramoconidial in condition, hyaline to sub-hyaline or very pale yellow, 10.5-20 X 7-10 µm; chains with pronounced interconidial isthmi.

On decorticated wood or bark; North America.

Specimens examined: Harvard Forest, Hamilton, Massachusetts, USA, D.H. Linder and D.P. Rogers, 5 October 1940, FH; Greenbelt, Maryland, USA, P.L. Lentz, July 1967, BPI.

This species was classified by Holubová-Jechová (1980b) in her section *Haplotrichum*, subsection *Paucidenticulata*, along with *H. chilense* (Linder) Hol.-Jech. These two taxa have some characteristics in common with *H. capitatum* (Link) Link, particularly possession of vesiculous conidiogenous cells, but *H. ochraceum* also bears some similarity to *H. dubium* in the form of its conidial chains. As alluded to above, in the discussion relating to *H. chilense*, *H. ochraceum* differs significantly from that species in the morphology of both its conidiogenous cells and conidial chains. Moreover, the presence of well-developed denticles in *H. ochraceum* is an added distinction differentiating the two. When viewed in the context of the genus as a whole, there is as much, if not more, morphological difference between these taxa as there is similarity.

Haplotrichum ovalisporium (Linder) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 7).

≡ *Oidium curtisii* Berk. var. *ovalisporium* Linder, *Lloydia* 5:204, 1942.

Teleomorph: unknown.

Colonies effuse, spreading, lanose, ochraceous-brown in color. Mycelium mostly superficial, composed of branched, septate, interweaving, anastomosing, smooth, hyaline, 1 to 3 µm wide hyphae. Conidiophores semi-

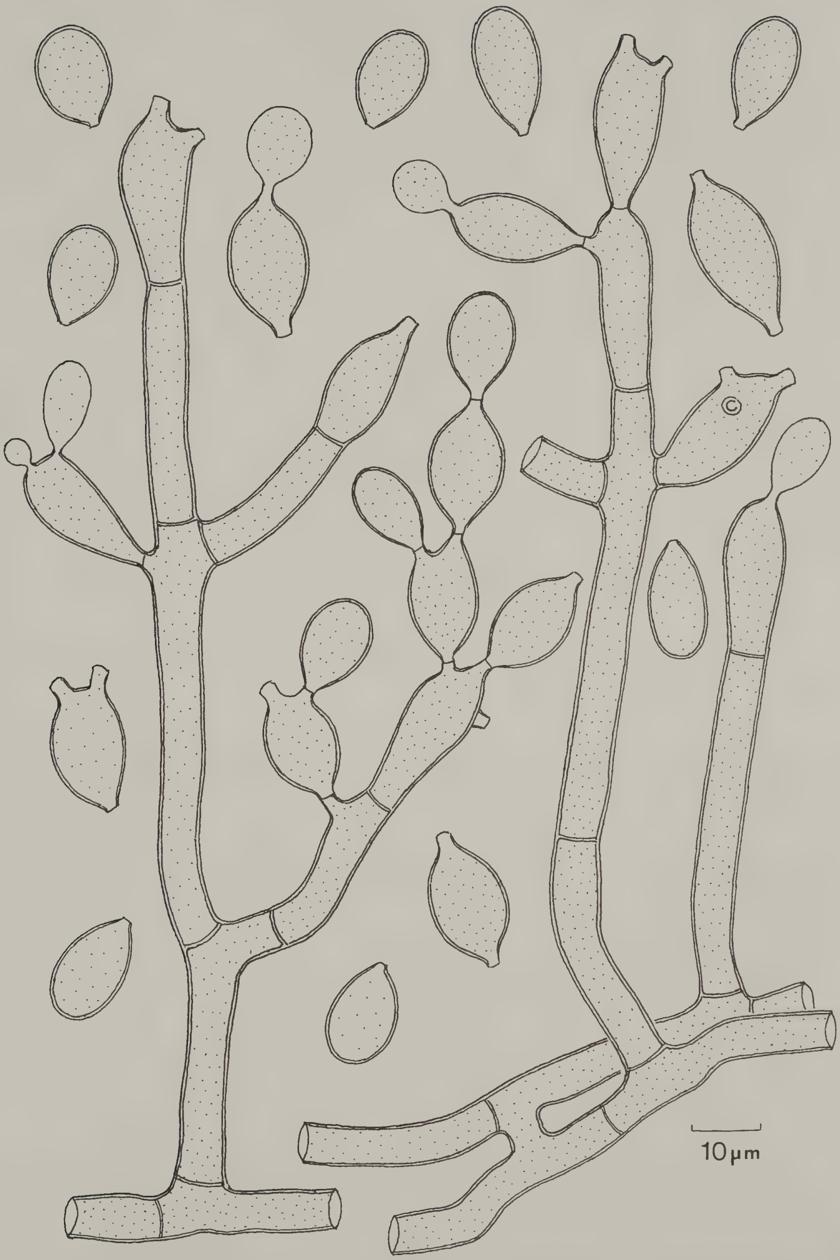

FIGURE 6. *Haplotrichum ochraceum*. Conidiophores and conidia.

macronematous, mononematous, ascending, more or less erect, branching at wide, close to right angles and gently curving upwards, straight to slightly flexuous, cylindrical, smooth, septate, comparatively thinner-walled, bearing well-developed denticles distally on the terminal cell and one or two of the intercalary, subtending cells, hyaline, up to 500 µm long, 5 to 8.5 µm in diameter. Conidiogenous cells polyblastic, integrated or discrete as lateral branches, terminal or intercalary, cylindrical or swelling to become broadly clavate or sub-globose and vesicle-like, bearing a number of distinct, 1.5-3 X 2-2.5 µm denticles at conidiation loci, up to 55 µm long where terminal, 105 µm long where intercalary, 5 to 11 µm wide. Terminal conidiogenous cells occasionally disarticulating by a schizolytic split in the delimiting septum, resulting in conidiophores becoming broadly and distinctly truncate at their apex. Conidia acropleurogenous, holoblastic, solitary or in short chains, dry, unicellular, smooth, moderately thick-walled, the inner wall layer appearing somewhat irregular and minutely pitted at maturity, ellipsoid or broadly limoniform or, where ramoconidial in form, broadly clavate to sub-globose, where intercalary bearing distinct papillae, pale to mid brown, 9-16 X 9-12.5 µm in size.

On decorticated wood and bark; Africa.

Specimen examined: Lulanga, Belgian Congo, D.H. Linder, 21 December 1926, FH, holotype.

This species was classified by Holubová-Jechová (1980b) in her section *Vesiculata*, subsection *Ramosa*.

By originally classifying this taxon as a variety of *H. curtisii*, Linder (loc. cit.) recognized the close similarity between the two. Although the most obvious and readily discernible difference lies in the shape of their respective conidia, certain other morphological distinctions exist. The conidiophores of both are broadly similar, but those of *H. ovalisporium* are straighter and their branching pattern, particularly frequency thereof and the orientation of branches relative to the main stipe, differs. In addition, terminally-produced conidiogenous cells of *H. curtisii* tend to be more vesiculose in form than do those of *H. ovalisporium*. Although some overlap of their characteristics occurs, the conclusion reached by Holubová-Jechová (1976) as to the distinctiveness of these two taxa is accepted herein, especially in view of the fact that the features by which they are distinguished appear to be constant. This is, perhaps, a good example of sibling species arising by divergence resulting from geographical separation of an originally panmictic population, constituting what is sometimes referred to as primary, allopatric speciation.

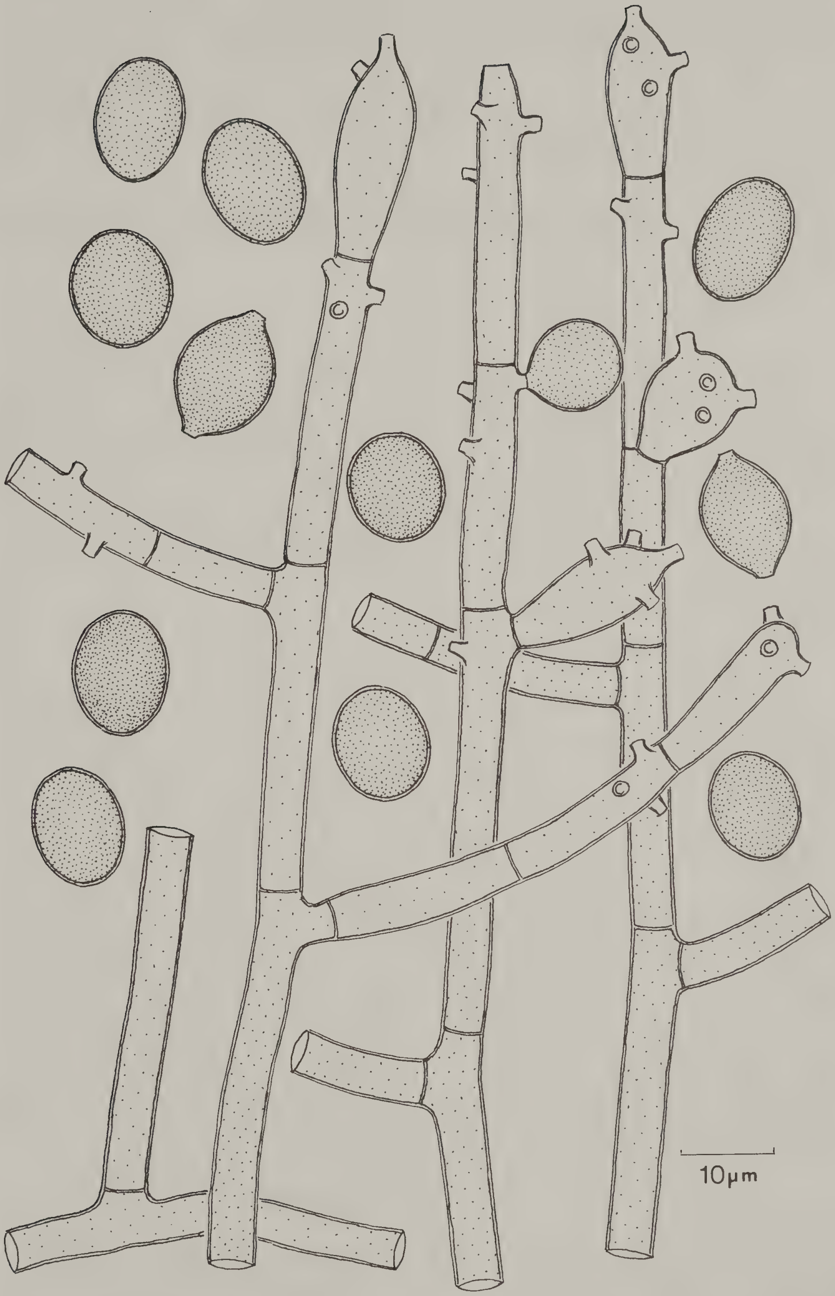

FIGURE 7. *Haplotrichum ovalisporium*. Conidiophores and conidia.

Haplotrichum ramosissimum (Berk. & M.A. Curtis) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 8).

≡ *Rhinotrichum ramosissimum* Berk. & M.A. Curtis, *Grevillea* 3:108, 1875.

≡ *Oidium ramosissimum* (Berk. & M.A. Curtis) Linder, *Lloydia* 5:192, 1942.

Teleomorph: unknown.

Colonies effuse, resupinate, usually densely hypochnoid, velvety, often becoming confluent and covering large areas of the substrate, at first pale creamish-buff, later becoming ochraceous to cinnamon-brown in color. Mycelium mostly superficial, composed of branched, septate, interweaving, occasionally anastomosing, smooth, hyaline to sub-hyaline, 1 to 3 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, but becoming somewhat prostrate when fully developed, usually abundantly branched, with branches and sub-branches oriented at wide angles, often producing a cruciate aspect, straight to somewhat flexuous, smooth, septate, with the transverse septa appearing slightly thicker than the adjoining periclinal wall, especially in the stipe, moderately thick-walled, denticulate, sub-hyaline to very pale yellowish, usually up to 300 µm long, 5 to 7 µm in diameter at the middle portion of the main axis, attenuating very slightly toward the apex. Conidiogenous cells polyblastic, integrated where terminal and intercalary, or discrete as lateral branches, which are usually oriented at right angles, broadly club-shaped to obovoid, determinate, typically bearing up to eight relatively large, conspicuous, cylindrical to cuneate denticles, with the distal extremity sometimes slightly convex following conidium detachment; up to 45 µm long where intercalary, otherwise 13-21 X 9-12 µm, denticles up to 4 µm long, 3 µm wide. Conidia acropleurogenous, holoblastic, in short, simple or branched chains, dry, unicellular, smooth, moderately thick-walled, obovoid where terminal, ellipsoid to limoniform if originating intercalarily, papillate, with the papillae variously pronounced, sub-hyaline, 8-21 X 7-10 µm in size.

On decorticated, decaying wood; North America.

Specimens examined: on bark of unidentified tree, Camp Lazarus Reserve, Delaware County, Ohio, U.S.A., W. B. and V.G. Cooke, 19 August 1968, [as *Oidium ochraceum* (Povah) Linder] BPI; on bark, Auburn, Lee County, Alabama, U.S.A., W.A. Baker, 22 August 2000, AUA.

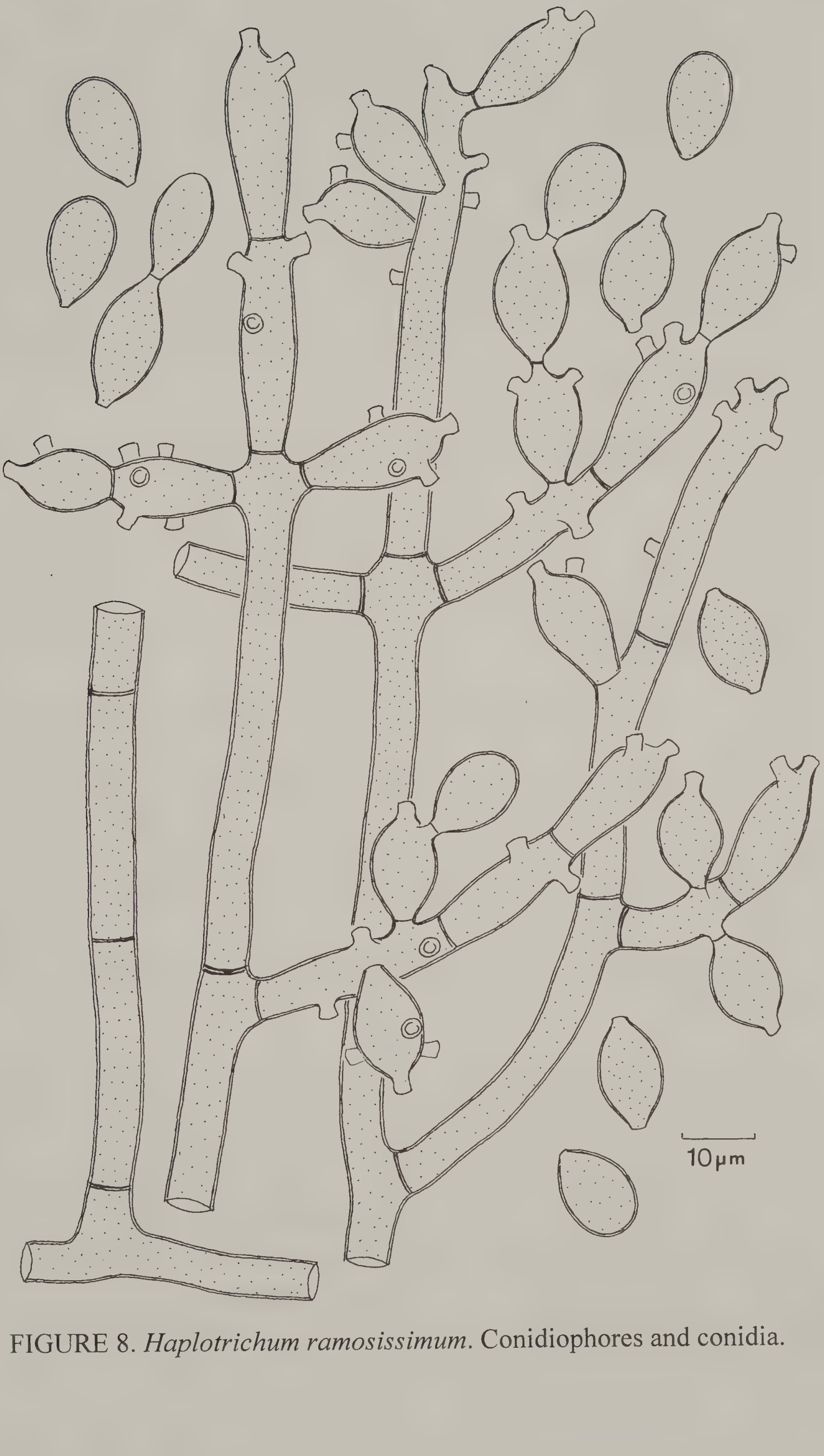

FIGURE 8. *Haplotrichum ramosissimum*. Conidiophores and conidia.

This species was classified by Holubová-Jechová (1980b) as the typifying taxon of her section *Vesiculata*, subsection *Ramosa*, of the genus *Haplotrichum*. As discussed in our previous contribution (Partridge *et al.*, 2001a), and alluded to above, the usefulness of the subgeneric classification proposed by Holubová-Jechová (1980b) remains questionable. The segregation of *Haplotrichum capitatum* (Link) Link [classified as the type of section *Haplotrichum*, subsection *Multidenticulata*] and *H. ramosissimum*, two species which have closely similar characteristics, particularly the morphology of their conidiogenous cells, in separate sections brings into question the significance and weight given to characterizing criteria. The only real difference between these two taxa lies merely in the degree of conidiophore branching.

Haplotrichum rubiginosum (Fr.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 9).

≡ *Sporotrichum rubiginosum* Fr., *Syst. mycol.* 3:417, 1832.

≡ *Rhinotrichum rubiginosum* (Fr.) Sumst., *Mycologia* 3:47, 1911.

≡ *Oidium rubiginosum* (Fr.) Linder, *Lloydia* 5:191, 1942.

= *Physospora rubiginosa* Fr., Summa Veg. Scand., p. 495, 1849.

= *Physospora elegans* Cavara, *Rev. Mycol.* 11:182, 1889.

= *Zygodesmus serbicus* Ranoj., *Ann. Mycol.* 8:397, 1910.

Teleomorph: *Botryobasidium robustior* Pouzar & Hol.-Jech., *Česká Mykol.* 21:69, 1967.

Colonies effuse, spreading, dense, velvety, cinnamon- to chocolate-brown. Mycelium mostly superficial, composed of branched, septate, interweaving, occasionally anastomosing, smooth, hyaline, 1 to 3 µm wide hyphae. Conidiophores semi-macronematous, mononematous, more or less erect, occasionally branching, frequently anastomosing, arcuately flexuous, cylindrical, smooth, septate, with walls somewhat thickened, bearing numerous denticles concentrated mainly in inflated terminal and sub-terminal or lateral cells and scattered in subtending intercalary cells, pale brown, becoming lighter towards the apical portions, usually up to 400 µm long, 8 to 9 µm in diameter. Conidiogenous cells polyblastic, integrated or discrete as

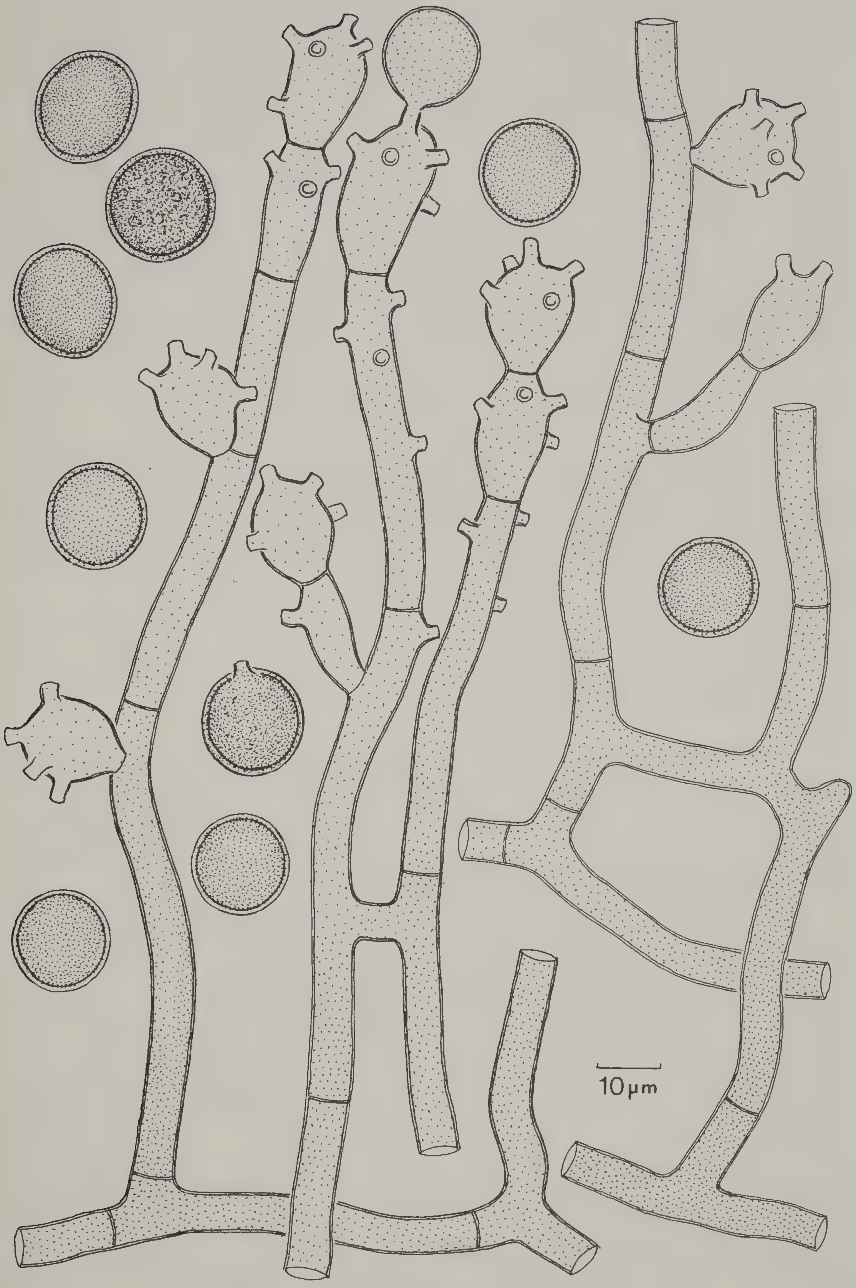

FIGURE 9. *Haplotrichum rubiginosum*. Conidiophores and conidia.

lateral vesicle-like cells, terminal or intercalary, varying in shape from cylindrical to clavate to sub-globose to somewhat pyriform, with up to eight prominent, up to 5 µm long, 2 µm wide, denticles, particularly when located terminally or laterally, where vesicular in form 11-15 X 10-11 µm in size. Lateral vesicular conidiogenous cells occasionally disarticulating. Conidia acropleurogenous, holoblastic, solitary, dry, unicellular, smooth, at first sub-hyaline to pale brown, becoming progressively thicker-walled and melanized, brown when fully mature with the inner wall layer appearing irregularly stratified or minutely pitted and the cellular contents granular, broadly ellipsoid when young, eventually assuming a sub-globose to globose shape, usually bearing a basal, truncate papilla, 13-16 X 12-16 µm in size.

On decaying wood; Europe and North America.

Specimens examined: Padua, Italy, P.A. Saccardo, November 1880, Mycotheca Veneta 1578, FH; Rockport, Kansas, USA, E. Bartholomew, 30 November 1892, [as *Monilia aureofulva* Cooke & Ellis] BPI; Belgrade, Serbia, N. Ranojevič, 22 October 1910, in Kabát & Bubak, Fungi Imperfecti Exsiccati 690, BPI.

This species was classified by Holubová-Jechová (1980b) in her section *Vesiculata*, subsection *Ramosa*.

Linder (loc. cit.) noted that this species was not, at that time, known from North America, although a number of collections had been identified under the names *Physospora rubiginosa* or *Rhinotrichum rubiginosum*. The view was expressed that such specimens were either *Haplotrichum curtisii* [as *Oidium curtisii*] or *Haplotrichum ramosissimum* [as *Oidium ramosissimum*], or even *Haplotrichum simile* [as *Oidium simile*], the misdeterminations being, in part at least, the result of the presence of rusty brown colony coloration. It seems uncertain that this assessment of specimen identification is entirely valid for it would be surprising if, for example, *H. ramosissimum* were confused with *H. rubiginosum*, because the two species are very different in morphology and pigmentation, the former having hyaline to sub-hyaline conidiophores and conidia. It is, however, entirely possible that *H. rubiginosum* and *H. curtisii* could have been mistaken for each other. The considerable muddle and perplexity surrounding application of names is probably reflective of the fact that critical characterization, adequate documentation, and, particularly, satisfactory typification of individual taxa remained wanting for many years. In the case of *H. rubiginosum*, absence of an extant type specimen for *Sporotrichum rubiginosum* led to the Saccardo Mycotheca Veneta issue being used to characterize the taxon and effectively chosen as its lectotype [see Linder (loc. cit.)]. As an illustration of the confusion, it can be noted that what is now known as *H. simile* was described under the name *Oidium aureo-fulvum* by Linder (loc. cit.), whilst the name *Oidium simile* was applied to the anamorph now known as *Allescheriella crocea* (Mont.) S. Hughes. It is now apparent that *H. rubiginosum* occurs in North America [see Pouzar and Holubová-Jechová (1967) and the specimen identity determination by the present authors (see citation above)].

Haplotrichum rubiginosum and, as already mentioned, *H. curtisii* have a broadly similar morphology, but are easily distinguishable by several features. Among these are presence of lateral vesicular conidiogenous cells and frequent conidiophore anastomoses in the former, as well as certain conidium peculiarities. Conidia of *H. rubiginosum* are consistently thicker-walled and appreciably more pigmented than are those of *H. curtisii*. Moreover, the conidiophore branching pattern of the two species differs, and distal localization of denticle production, as well as a tendency for terminal cell disarticulation, are characteristics which serve to further distinguish *H. curtisii*.

Haplotrichum simile (Berk.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 10).

≡ *Oidium simile* Berk., *Hooker's J. Bot.* 4:310, 1845.

≡ *Acladium simile* (Berk.) S. Hughes, *Can. J. Bot.* 36:732, 1958.

= *Monilia aureo-fulva* Cooke & Ellis, *Grevillea* 8:12, 1879.

≡ *Oidium aureo-fulvum* (Cooke & Ellis) Linder, *Lloydia* 5:189, 1942.

≡ *Alysidium aureofulvum* (Cooke & Ellis) M.B. Ellis, More Dematiaceous Hyphomycetes p. 51, 1976.

= *Oidium biforme* Linder, *Lloydia* 5:188, 1942 [*fide* Pouzar and Holubová-Jechová (1969)].

Teleomorph: *Botryobasidium simile* Pouzar & Hol.-Jech., *Česká Mykol.* 23:99, 1969.

Colonies effuse, scattered, but usually becoming confluent, hypochnoid, dense, velvety, powdery, at first whitish-buff, sometimes with a somewhat yellowish tinge, eventually becoming cinnamon-brown to rust-colored, often with the extreme margin remaining paler. Mycelium mostly superficial, composed of branched, septate, interweaving, frequently anastomosing, smooth, hyaline to sub-hyaline, with some eventually becoming yellowish-brown, 1 to 3 µm wide hyphae. Conidiophores semi-macronematous to macronematous, mononematous, ascending, more or less erect, of two differing types; predominantly somewhat short, commonly with one or two upwardly curving branches, occasionally anastomosing below, usually slightly flexuous, smooth, septate, relatively thin-walled, cylindrical, sub-hyaline but with the terminal and sometimes the penultimate cells becoming thicker-walled and discernibly melanized, usually up to 200 µm long, 5 to 8 µm wide; or, rarely, much longer, somewhat seta-like, unbranched, mostly straight, smooth, septate, appreciably thicker-walled, cylindrical, sometimes nodosely bullate with one or more distinct intercalary swellings along their length, pale- to mid-brown, up to 700 µm in length, 5 to 8 µm wide. Conidiogenous cells monoblastic or, occasionally, polyblastic, integrated, determinate, terminal or, very rarely, intercalary, cylindrical or, more often, distinctly swollen immediately below the conidiation locus, bearing one or two, shallow, broad, flat denticles, up to 40 µm long, 5 to 6 µm wide in the narrower portion, 11 to 12 µm wide at the swollen distal part; where intercalary in the longer, unbranched conidiophore type, giving rise to a single, lateral, short conidial chain. Conidia acropleurogenous, holoblastic, in relatively short, simple or, less often, branched chains of usually three to five, sometimes more, dry, unicellular, smooth, moderately thick-walled, broadly ellipsoid to almost sub-globose, limoniform where produced intercalarily, bearing one to three slightly-protuberant, relatively wide, shallow denticles, pale- to mid-brown, often densely granular, 18-25 X 14-17 µm in size.

On decorticated, decaying wood or bark; Europe and North America.

Specimens examined: on pine, Newfield, New Jersey, USA, J.B. Ellis, 21 November 1892, BPI; Ann Arbor, Michigan, USA, F.E. Langdon, 3 June 1893, BPI; Buffalo, New York, USA, G.W. Clinton, 18--, BPI; Silver Spring, Maryland, USA, B.C. Brunstetter, 25 December 1934, BPI; on oak log, Fort Hill State Memorial, Highland County, Ohio, USA, W.B. and V.G. Cooke, 2 December 1975, BPI [as *Oidium rubiginosum* (Fr.) Linder].

This species was classified by Holubová-Jechová (1980b) in a section of its own, *Haplotrichum* sect. *Biformia*, on account of the presence of polymorphic conidiophores. The synonymy of *Oidium biforme* Linder with *H. simile,* according to Pouzar and Holubová-Jechová (1969), is accepted herein although the type species of the former has not been examined. The

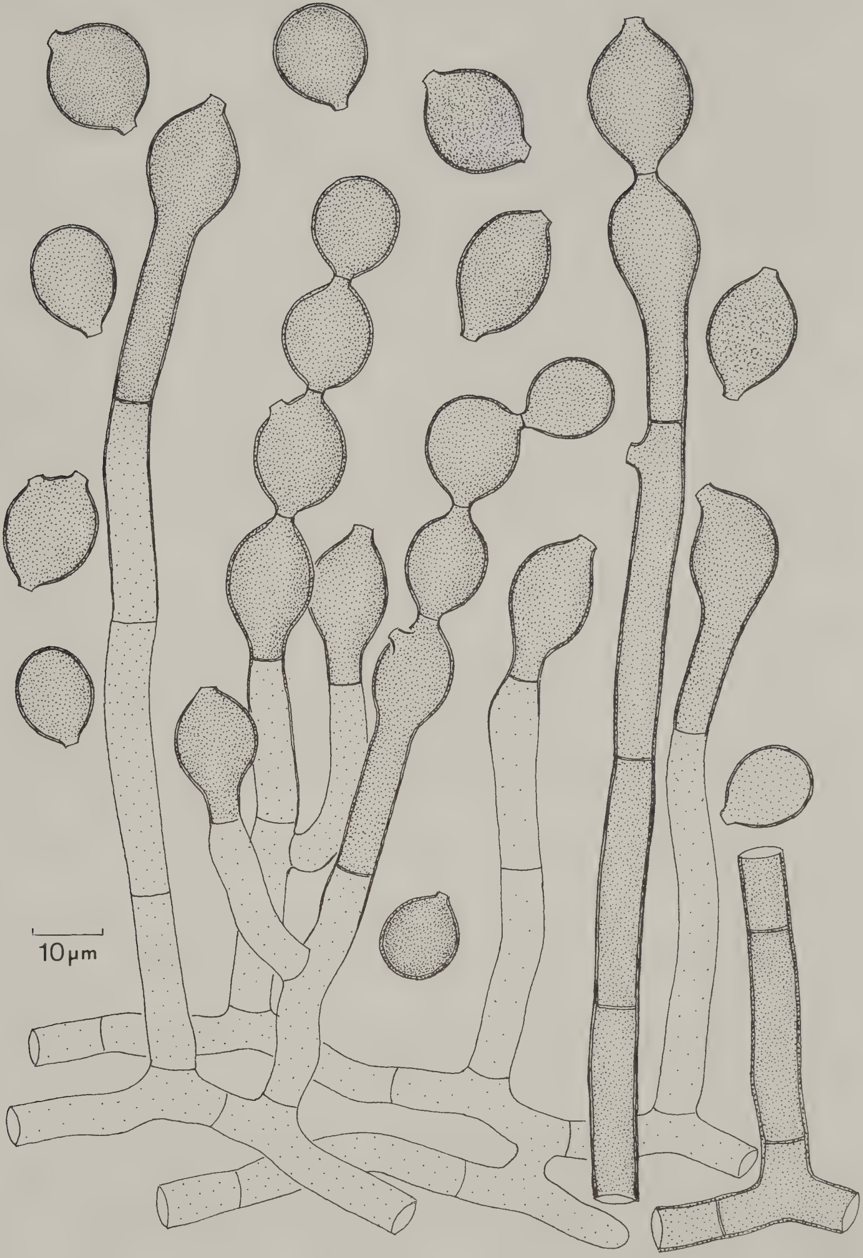

FIGURE 10. *Haplotrichum simile*. Conidiophores and conidia.

presence of long, unbranched, substantially pigmented conidiophores in a number of the collections examined confirms the conspecificity of these two taxa.

As has apparently been the case with several *Haplotrichum* names, the binomial *H. simile* has been misapplied to collections of other taxa and, similarly, other species have been misidentified as *H. simile*. As examples of this, a collection made by Elam Bartholomew in Rockport, Kansas, on 13 November 1893, was named *Monilia aureo-fulva* and cited among the specimens of *Oidium aureo-fulvum* [= *Haplotrichum simile*] examined by Linder (loc. cit.). A study of this material, housed in BPI, by the present authors, however, indicates that this collection is, in fact, one of *Allescheriella crocea*. Another collection of *A. crocea*, determined as *M. aureo-fulva* [= *O. simile*], was made near Wilmington, Delaware, on 15 October 1890, ex herb. A. Commons [BPI]. The more recent collection cited above among the specimens examined during the course of this study and misnamed *O. rubiginosum* indicates continued difficulty in applying correct binomials to specimens belonging to this complex.

Within the genus *Haplotrichum*, *H. simile* is, perhaps, among the most distinctive species. So much so that it is somewhat surprising that it has been confused with others. The polymorphic nature of the conidiophores, together with the presence of the characteristically bullate terminal cells, are features which appear to be unique to this taxon. The relatively long chains of pigmented conidia with broad, short, interconidial isthmi are other aspects which serve to distinguish *H. simile* from other species.

Haplotrichum tomentosum (Berk. & M.A. Curtis) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 11).

≡ *Hymenochaete tomentosa* Berk. & M.A. Curtis, *J. Linn. Soc.* 10:335, 1868.

≡ *Trichosporium tomentosum* (Berk. & M.A. Curtis) Pat., *Bull. Soc. mycol. France* 10:79, 1894.

[≡ *Haplotrichum tomentosum* (Pat.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 ≡ *Trichosporium tomentosum* Pat., *Bull. Soc. mycol. France* 10:79, 1894 (basionym authority miscitation)]

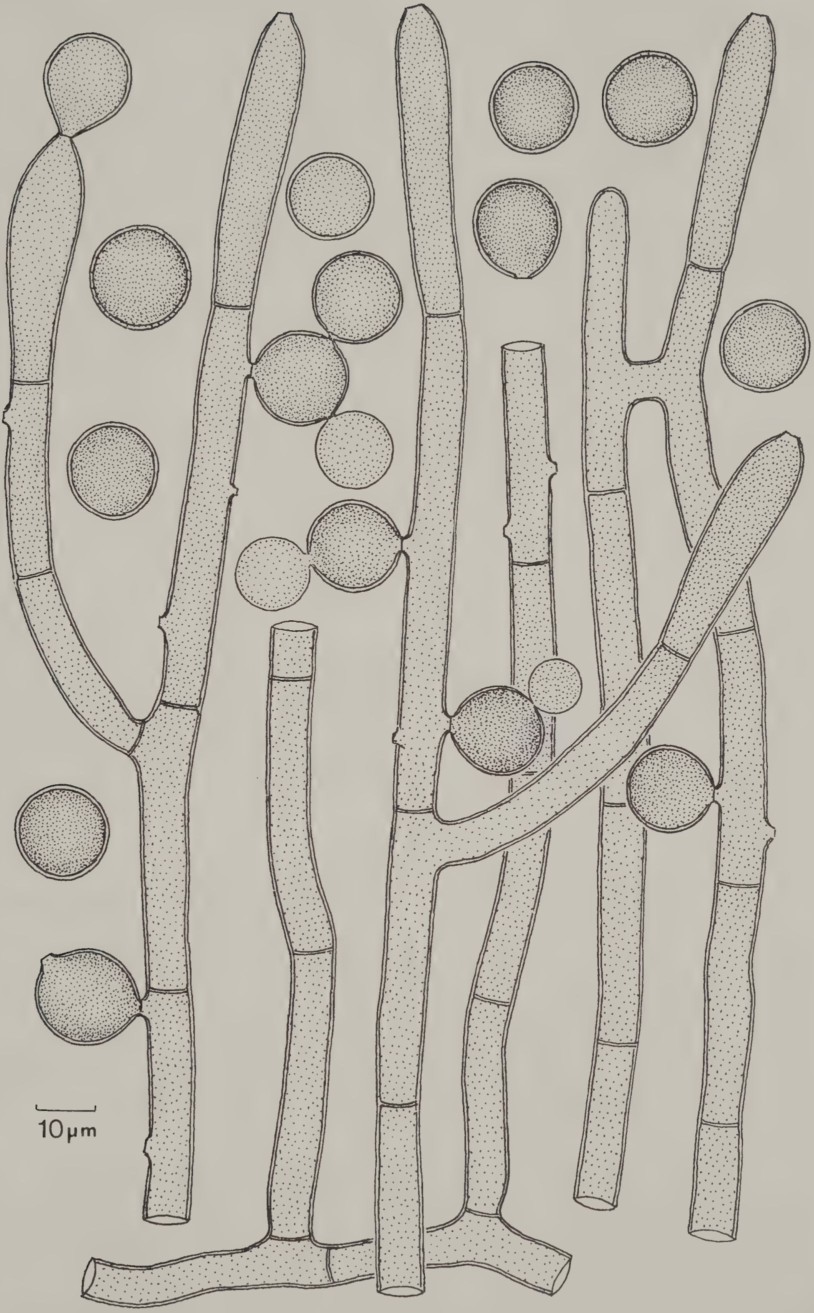

FIGURE 11. *Haplotrichum tomentosum*. Conidiophores and conidia.

Teleomorph: *Botryobasidium lembosporum* (D.P. Rogers) Donk, *Fungus* 28:26, 1969.

Colonies effuse, spreading, loosely lanose to pilose with long ascending hairs, appearing coarse, at first ochraceous-cream in color, becoming bronze. Mycelium mostly superficial, composed of branched, anastomosing, septate, smooth, hyaline to sub-hyaline, 1 to 3 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, simple or bearing one or two arcuate branches originating in the distal portion, frequently anastomosing, straight to very slightly flexuous, smooth, septate, sometimes slightly constricted at septa, moderately thick-walled, with shallow projections at conidiogenous loci, cylindrical but with the terminal cell somewhat inflated, sub-hyaline in the basal region, becoming pale to mid brown toward the apex, up to 700 µm long, 7 to 11 µm wide. Conidiogenous cells monoblastic where apical, otherwise polyblastic, integrated, determinate, terminal or intercalary, cylindrical or clavate, where intercalary bearing one or more shallow, broad, flat, stubby denticles, where terminal with a single, apical, truncate conidiation locus and no denticle-like projection, up to 100 µm long, where distally swollen up to 13 µm wide. Conidia acropleurogenous, holoblastic, in short, simple or branched chains, dry, unicellular, smooth, becoming moderately thick-walled at maturity with the inner wall layer appearing minutely stratified or pitted, sub-globose to globose, occasionally bearing one or more very shallow papillae or basally truncate, pale to mid brown, 11-17 X 11-16 µm in size.

On bark or wood; Caribbean.

Specimen examined: Cuba, C. Wright, #228, undated, FH, holotype.

This species was classified by Holubová-Jechová (1980b) in her monotypic section *Vesiculata*, subsection *Simplicia*, on the basis of its conidiophores being unbranched. While the conidiophores of *H. tomentosum* are frequently unbranched, this distinction cannot be considered substantive enough to warrant separate segregation of this taxon and is again illustrative of the artificiality of the generic subdivision proposed.

Haplotrichum tomentosum is as distinct from other species as is *H. simile* but in partly a different way. The gradual gradation of conidiophore pigmentation where the distal portion is appreciably more melanized is a particularly distinguishing feature. The shallow, barely projecting conidiogenous denticles is another notable characteristic, as is the complete absence of any discernible interconidial isthmi. Because of the latter oddity, laterally-formed primary conidia, ramoconidial or otherwise, do not assume a vesicular morphology comparable to that encountered in *H. rubiginosum* and a number of other species. As a result, such conidia have almost an identical morphology to those produced terminally on a chain. This peculiarity brings into question the matter of terminology application. Such authors as Linder (loc. cit.) and Pouzar and Holubová-Jechová (1967) employ the term 'sporogenous vesicles' for what are, essentially, ramoconidia, albeit, unlike the condition in *H. tomentosum*, having a different morphology from typical conidia. In this regard, a comparison of *H. rubiginosum* and *H. tomentosum*, and of *H. ochraceum* and *H. chilense*, illustrates the unsatisfactory aspect of inconsistent term usage for what are essentially the same elements.

Haplotrichum vesiculosum (Linder) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 12).

≡ *Oidium vesiculosum* Linder, *Lloydia* 5:193, 1942.

Teleomorph: unknown.

Colonies effuse, thin, sparse, lanose to somewhat tufted, ochraceous buff in color. Mycelium mostly superficial, repent, composed of branched, septate, interweaving, anastomosing, smooth, hyaline, 1 to 3 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight or somewhat flexuous, branching predominantly in the basal region but occasionally higher up, branches oriented at an acute angle relative to the main axis and assuming a more or less parallel position, or divergent, occasionally anastomosing, smooth, septate, moderately thick-walled, denticulate primarily in the sub-apical portion, gradually tapering distally and becoming somewhat contorted or irregularly geniculate, hyaline, up to 200 µm long, 6 to 8 µm wide, attenuating to 3 to 4 µm wide. Conidiogenous cells polyblastic, integrated or discrete as ramoconidia, terminal or intercalary, determinate, mostly cylindrical but variously shaped depending upon position, pyriform to sub-globose where terminal or lateral, bearing distinct, well-developed, up to 5 µm long, up to 3 µm wide denticles. Conidia acropleurogenous, holoblastic, solitary or in short chains, dry, unicellular, smooth, moderately thick-walled, mostly obovoid, narrowly sub-truncate at the base, hyaline, 11-20 X 9-12 µm in size, where ramoconidial sub-globose, up to 20 µm in diameter.

On decorticated wood; South America.

Specimen examined: Punta Arenas, Chile, R. Thaxter, January 1906, FH, holotype.

This species was classified by Holubová-Jechová (1980b) in her section *Vesiculata*, subsection *Ramosa*. It is known only from its type collection and is readily identified by the slender, attenuating, somewhat undulate to geniculate conidiophore tips. The fertile, distal ends of the conidiophores are, in fact, unlike those of any other *Haplotrichum* species. The presence of distinctly vesiculate, subglobose, discrete conidiogenous cells produced directly from conidiophores or occurring intercalarily in chains is another notable feature of this taxon. These are, essentially, ramoconidia which become readily detached and are, presumably, capable of germination. In *H. vesiculosum*, as noted previously, these structures are more fully differentiated morphologically than is the case in other species of this genus. These were referred to as vesicles in the description provided by Linder (loc. cit.). Among taxa possessing hyaline conidia Linder (loc.cit.) considered *H. vesiculosum* to most closely resemble *Haplotrichum pulchrum* (Berk.) Hol.-Jech [as *Oidium pulchrum* (Berk.) Linder; ≡ *Rhinotrichum pulchrum* Berk.]. The latter differs by having vesiculate conidiogenous cells that are ellipsoid in shape and which originate not only terminally but also laterally from intercalary conidiophore cells.

DISCUSSION

In addition to the fifteen species of *Haplotrichum* described in this and our previously published contribution (Partridge *et al*., 2001a), a number of additional entities remain to be considered and their taxonomic status reviewed. These include four which were treated by Linder (loc. cit.) and have been transferred to *Haplotrichum* by Holubová-Jechová (1976); namely *H. magnisporum* (Linder) Hol.-Jech., *H. pulchrum* (Berk.) Hol.-Jech., *H. sphaerosporum* (Linder) Hol.-Jech., and *H. tenerum* (Sumst.) Hol.-Jech. Several taxa included by Linder (loc. cit.) in *Oidium* Link, but whose classification has not been subsequently reconsidered, such as *O. armeniacum* (Berk. & M.A. Curtis) Linder [≡ *Rhinotrichum armeniacum* Berk. & M.A. Curtis] and *O. morgani* Linder [= *Physospora elegans* Morgan], are in need of reevaluation. Whether or not these, and perhaps some others, belong in *Haplotrichum* remains undetermined. Among further taxa currently classified in *Haplotrichum* are three species originally described by Holubová-Jechová (1969) in *Oidium* but which were later transferred into the former genus by Holubová-Jechová (1976). Two new species have also been described in recent years; *H. parmastii* G. Langer [in Langer & Langer (loc. cit.)] and *H. perseae* R.F. Castañeda (1996). Moreover, three *Botryobasidium* anamorphs

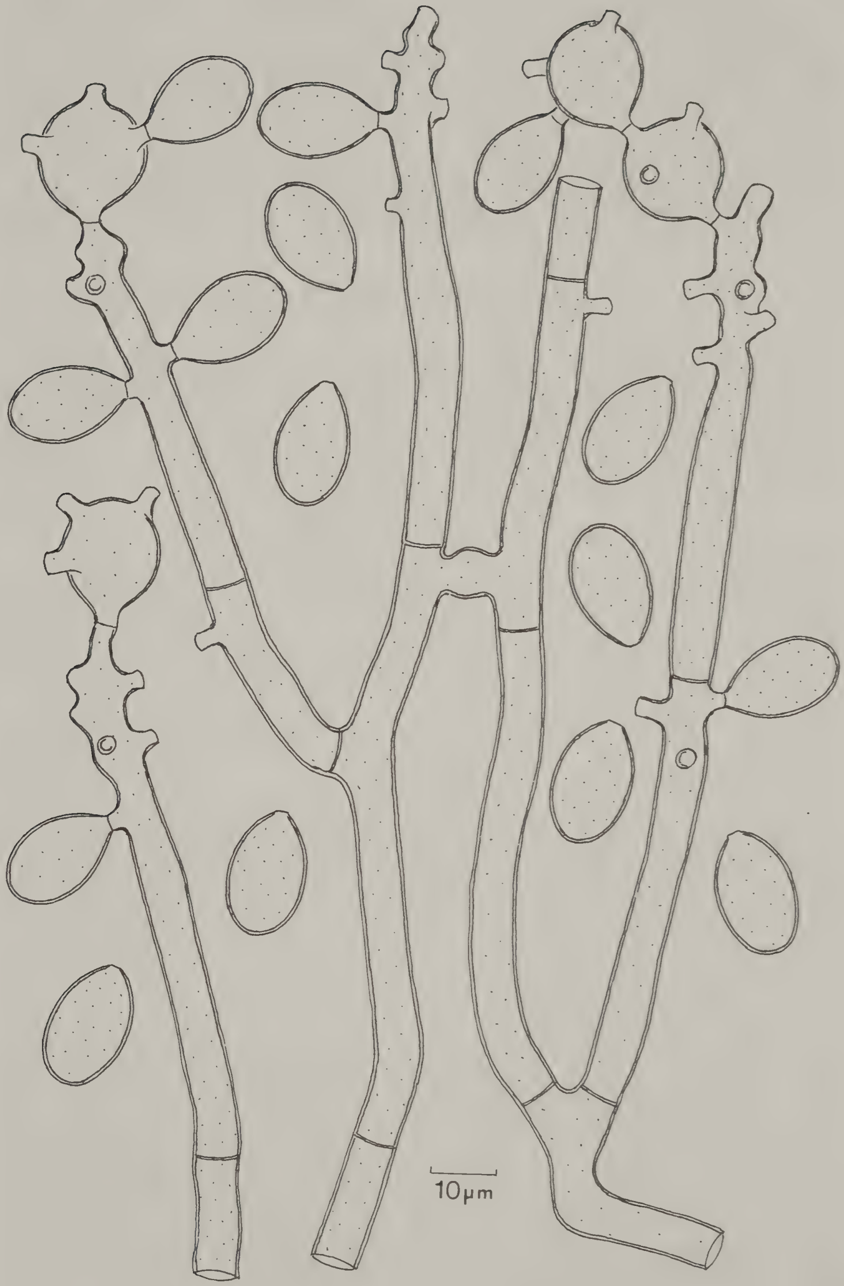

FIGURE 12. *Haplotrichum vesiculosum*. Conidiophores and conidia.

are known which have not been named as species of *Haplotrichum* but which clearly belong in that form-genus. In view of the fact that these anamorphs may be found in nature independently of the teleomorphs, the establishment of binomials for them in *Haplotrichum* is, perhaps, desirable. A consideration of these and the other remaining taxa will form the subject of future articles, as will a revision of the taxonomy of several species currently classified in *Alysidium* Kunze [now a synonym of *Haplotrichum*] but which are clearly not congeneric with the anamorphs described above [see Partridge *et al.* (2001a)].

ACKNOWLEDGMENTS

We are grateful to Drs. Donald H. Pfister [FH] and Amy Y. Rossman [BPI] for the loan of specimens on which this study was based. We thank Dr. J. Leland Crane, Illinois Natural History Survey, Champaign, and Dr. C.J.K. Wang, State University of New York, Syracuse, for reviewing the manuscript.

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MYCOTAXON

Volume LXXVIII, pp. 161-165 April-June 2001

PEZICULA MAGNISPORA, A NEW SPECIES ON AN HERBACEOUS PLANT

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Abstract

A fungus collected in western Sichuan, China in 1997 is recognized as a new species of *Pezicula* based on morphological characters. The species is named *Pezicula magnispora* due to its large ascospores and comparatively small apothecia. Ascospores are brown and septate to muriform when discharged, but remain hyaline within the asci. The fungus grows on the stem of a dead herbaceous plant. The distinctively large spores and type of substrate establish this as a new species.

Keywords: China, Dermateaceae, Helotiales

Introduction

An interesting cup fungus belonging to the genus *Pezicula* (Dermateaceae, Helotiales) was discovered on Gongga Mountain, western Sichuan province in China in the summer of 1997. The fungus differs from existing species in this genus by its very distinctive large ascospores (46-58 x 14.5-20 μm) and its unusual substrate (on an herbaceous plant).

Description

Pezicula magnispora Z.H.Zhong & Zheng Wang, sp. nov. (Fig.1)

Apothecia parva (usque ad 1.5 mm in diametro), stipitato-discoidalia, eorum margine receptaculoque hirsuta, a stomatibus hospitis orientia, in caulibus extus annulum nigrum formantia. Asci inoperculati, Mlz+. Ascosporae magnae, 46 - 58 x 14.5 - 20 μm, oblique late fusiformes, in asco hyalinae aseptataeque, sed post emissionem brunneae, septatae et sub-muriformes. Substratum: Caules sicci plantarum herbacearum.

Typus: In caulibus siccis plantarum herbacearum, Sichuang, Mt. Gongga, Sina, 19 Aug. 1997, Zheng Wang, WZ2097, holotypus: HMAS 75908; isotypus: FH-wz2097.

ANAMORPH: Unknown.

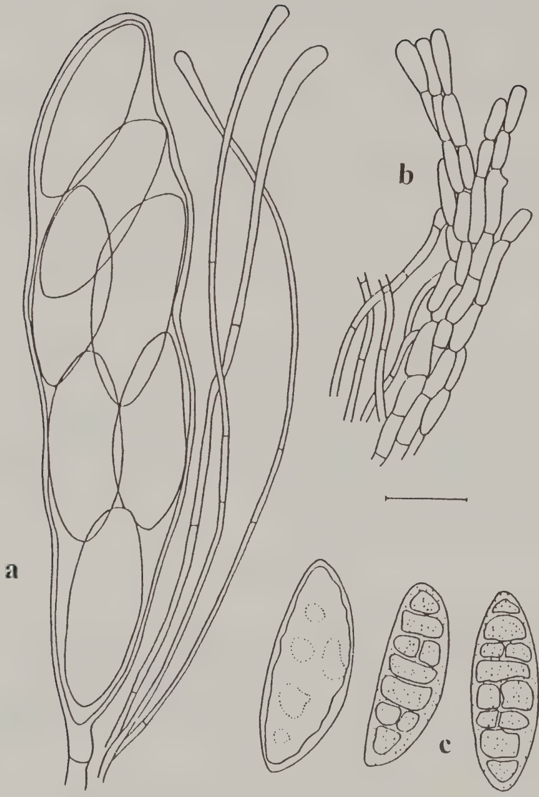

Fig. 1 *Pezicula magnispora*: **a**. Ascus with ascospores and paraphyses; **b**. Outermost ectal excipulum tissue; **c**. Ascospores (one young on the left, two mature on the right); scale = 20 μm.

DESCRIPTION: **Apothecia** erumpent, solitary, or gregarious in groups of two on a basal stroma, 1-3 mm tall when dry, stipitate, arising from a stromatized area of the host tissue, stipe short, yellow, brown or black toward the base, 0.5-2 x 0.3-1 mm. **Disc** circular, plane, bright orange when fresh, orange or pale yellow when dry, 0.7-1.5 mm diam when dry. **Receptacle** yellow, downy, with whitish hairs over the surface of the receptacle and margin.

Basal stroma immersed, carbonaceous, occurring as a black patch or ring on the surface of the host tissue at the base of the apothecium, tissue brown, consisting of angular cells with orange-brown thickened walls; the inner cells in the base of the stalk hyaline, angular to globose with slightly thickened walls. **Ectal excipulum** 40 to 55 μm thick, textura prismatica, parallel to the outer surface; outermost cells narrow, sometimes hyaline, mostly brown, 8-16 x 3-4 μm, joining together forming hair-like projections with interwoven hyphae; cells in underlying region hyaline, larger, 10-30 x 4-8 μm in size; innermost cells pale yellow, slender, 10-20 x 1.5-3 μm, not sharply delimited from medullary tissue; cells at the flank more slender and compact. **Medullar excipulum** up to 250 μm thick, pale yellow, textura intricata. **Subhymenium** pale yellow or light brownish, composed of interwoven cells, textura intricata.

Hymenium light yellow, about 280 μm thick. **Asci** cylindrical-clavate with narrow, short, stalk-like base, thick-walled, 170-190 x 28-32 μm, 8-spored, inoperculate, Mlz+, ascus top blue forming a wide broad ring zone in Melzer's Reagent. **Ascospores** large, broad-fusoid, asymmetrical with one side more flat than the other, transversely septate to muriform, spores usually with 5-9 transverse and 0-6 longitudinal or oblique septa; thin-walled, hyaline, aseptate or septate while in the asci, thick-walled, brown, transversely septate to muriform after discharge, usually slightly narrower or longer when mature, 46-58 x 14.5-20 μm, L/W (length/width) 2.6-3.2. **Paraphyses** filiform, septate, simple, obtuse, hyaline, cylindrical, 2-3 μm wide at the apex.

SUBSTRATA: On dead herbaceous plant stalk of an unknown species.

DISTRIBUTION: Known from a single collection designated above.

ETYMOLOGY: The epithet *magnispora* describes the distinctive large spores of this fungus.

Discussion

Very large ascospores can be encountered in the operculate discomycetes Pezizales, but are rare in the Helotiales, in which ascospores are mostly less than 15 μm long (Eckblad 1968). *Geoglossum* and *Trichoglossum* (Geoglossaceae) often have long spores more than 100 μm, but the spores are very narrow (Mains 1954). Larger spores (around 30-40 x 10-15 μm) can be found in some species of *Pezicula* (Groves 1939, Verkley 1999), but none are reported to be as large as those in this fungus.

This fungus from China has septate to muriform spores, which turn brown after discharge. This can be seen often in the genus *Pezicula*. Aside from spore characters our fungus also is similar to the genus *Pezicula* in having bright-colored apothecia, stromatized tissue from which one or more apothecia arises, and clavate asci with a stalk. Most species of *Pezicula* are associated with anamorphs that forms ellipsoid conidia, and the anamorph usually is a species of *Cryptosporiopsis* (Verkley 1999). However, no anamorph has been found associated with this fungus. Besides the distinctively large spores of this fungus, the substrate is also unusual. It was found on dead stems of an herbaceous plant, while most species of *Pezicula* grow on bark (Groves 1939, Dennis 1974, Verkley 1999). These spore and substrate differences serve to distinguish *P. magnispora* from other species of *Pezicula.*

Relatively larger or longer spores found in species of *Pezicula* include those of *P. acericola* (20-37 x 6.5-10.5, L/W 3.2-3.5), *P. aesculea* (19-39.5 x 5.5-10, L/W 3.6-4.4), *P. carpinea* (18.5-39.5 x 9-14.5, L/W 2.1-2.4), *P. corni* (22-42 x 8-17.5, L/W 2.3-2.6), *P. crataegicola* (25-39.5 x 12.5- 20.5, L/W 1.9-2.2), *P. eucrita* (25-42 x 6.5-9, L/W 4.0-5.1) and *P. ocellata* (23.5-42 x 9.5-17.5, L/W 2.1-2.7) (Verkley 1999). Among them the spores of *P. corni* and *P. ocellata* seem to be the closest to those of *P. magnispora* in both width and length, but the length of these spores still does not reach those of *P. magnispora* (46-58 x 14.5-20 μm, L/W 2.6-3.2). *P. ocellata* has a few giant spores of up to 50 μm long (Verkley 1999), which reaches the range in *P. magnispora*, but the spore shapes are quite different. In *P. ocellata* the L/W ratio of ascospores is larger, the spore ends are more round than those in *P. magnispora*, and muriform spores are not found.

A few species occur on substrates other than bark, such as the phylloclade-inhabiting species *P. tasmanica* (Zhuang & Korf 1988) and *P. eucalypti* on seed pods (Iturriaga & Korf 1997). However, the hosts of the 26 accepted species of *Pezicula* are all associated with woody plants (Verkley 1999). Among them *P. cinnamomea* has probably the widest range of hosts. Many collections of *P. cinnamomea* grow on bark of trees and shrubs such as *Cytisus, Fagus, Fraxinus, Ilex, Juniperus, Larix*, *Lindera* and *Ostrya*. *P. cinnamomea* has ascospores similar to those in the new species, *P. magnispora.* In both species the ascospores are hyaline and non-septate before discharge, later they develop some transverse septa (3-7 septa in *P. cinnamomea,* 5-9 in *P. magnispora*), and finally become brown and muriform with several oblique or longitudinal septa. The shapes of the ascospores inferred from length/width ratio (L/W) are also close (2.7-3.4 in *P. cinnamomea,* 2.6-3.2 in *P. magnispora*). However, spores of *P. magnispora* are much larger than in *P. cinnamomea* and have more pointed ends. The ascus iodine reaction is different in these two species (Mlz- in *P. cinnamomea* and Mlz+ in *P. magnispora*). In *P. cinnamomea* conidia are produced directly from the ascospores after ascospore liberation. This is not seen in *P. magnispora.*

To conclude, *P. magnispora* has very distinctive large muriform ascospores, a well-developed stipe and occurs on an herbaceous substrate. This combination of characters is not observed in other species of *Pezicula.*

Acknowledgements

We sincerely thank Drs. Teresa Ituriaga, Wen-Ying Zhuang and Thorsten H. Lumbsch for discussion and important suggestions. We are grateful to Drs. Gustavo Romero and Jianyun Zhuang for the Latin diagnosis. We are also deeply indebted to other members in the field expedition including Drs. David E. Boufford, Michael J. Donoghue, David Hibbett, Mr. Yu Jia and Mr. Rick Ree for encouragement and great support. This work was supported by the National Science Foundation grant DEB-95-21944 and DEB-97-05795.

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MYCOTAXON

Volume LXXVIII, pp. 167-173 April-June 2001

ELEUTHEROMYCES LONGISPORA SP. NOV., WITH A HYPHOZYMA SYNANAMORPH ISOLATED FROM A DECAYING BASIDIOMA OF TRAMETES VERSICOLOR

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ABSTRACT

A new hyphomycete, *Eleutheromyces longispora*, isolated from a decaying basidioma of *Trametes versicolor* is described. This fungus is characterized by the pycnidial conidia that are significantly longer than those of previously described species of the genus and possess apical-appendages with a swollen and slightly thick-walled basal part. On potato dextrose agar (PDA), pycnidial conidia of *E. longispora* usually become two-celled by forming a transverse septum before germination. Conidia of the *Hyphozyma* morph develop not only from the germ tubes but also directly from the main bodies of pycnidial conidia. The conidiation is usually sympodial but occasionally annellidic. Young colonies are mucoid on PDA but sometimes form patches of aerial mycelium containing many cylindrical conidia that develop on sympodially elongating conidiogenous cells. These conidia secede, leaving prominent scars on the conidiogenous cells. This type of conidiation does not occur in other species of the genus.

Key words: fungal taxonomy, fungicolous fungi, new species.

Paper No. 343 of the Tottori Mycological Institute.

INTRODUCTION

Eleutheromyces Fuckel is a coelomycetous genus characterized by its pycnidia bearing at the apex a sticky globose mass of spindle-shaped conidia with two terminal appendages (Malloch, 1974). *Eleutheromyces subulatus* (Fr.) Fuckel, the type species for the genus, and *E. mycophila* (Höhnel) Nag Raj were accepted in the genus by Nag Raj (1993). Both species have been recognized as fungicolous fungi. Sigler (1990) found that *E. subulatus* produced a *Hyphozyma* synanamorph and the connection between these morphs was confirmed by Tsuneda et al. (1995). Tsuneda et al. (1997) reported that the *Hyphozyma* synanamoph is the causal agent of black spot disease of *Lentinula edodes* (Berk.) Pegler basidiomata.

We recently collected a decaying basidioma of *Trametes versicolor* (L.: Fr.) Pilát bearing a *Hyphozyma*-like fungus on its hymenial surface. In culture, this fungus produced an *Eleutheromyces* morph that differed markedly with the known species of the genus. Therefore, we describe it herein as a new species, *E. longispora* N. Maekawa & Tsuneda. It's cultural features are also described and discussed.

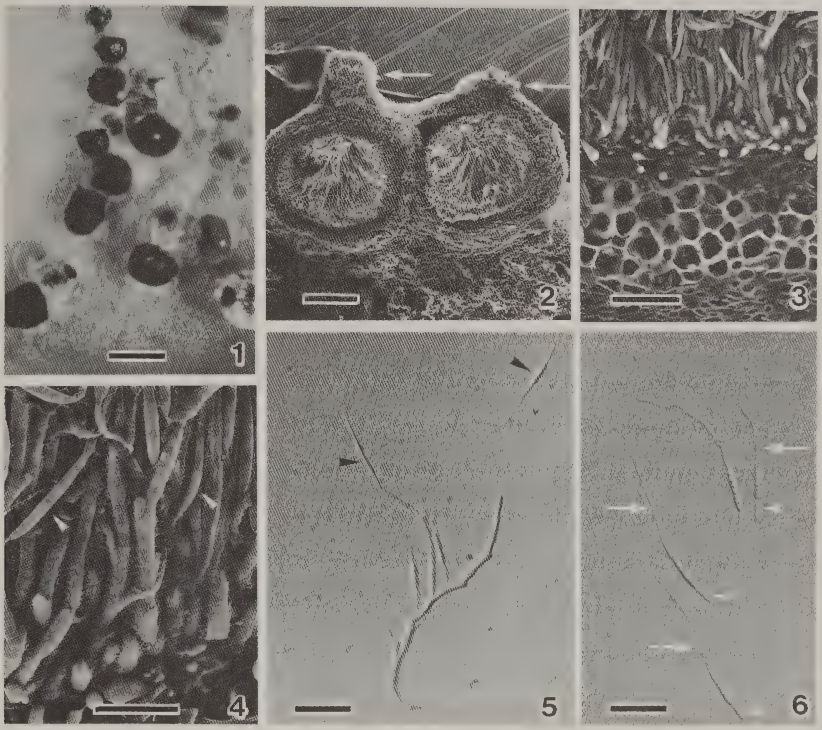
MATERIALS AND METHODS

A decaying basidioma of *Trametes versicolor* bearing *Hyphozyma*-like colonies was collected on November 1995 on a shiitake bedlog (*Quercus serrata* Thunb.), at Shinji-cho, Yatsuka-gun, Shimane Prefecture. Masses of yeast-like cells occurring on the hymenial surface were taken with a sterile needle and plated on potato dextrose agar (PDA, Difco, Detroit). An isolate thus obtained, TMIC (Tottori Mycological Institute Culture Collection) 32112, was used throughout this study. The optimum growth temperature of this fungus was determined by growing it on malt extract agar (MEA, Difco, Detroit) plates at different temperatures (4–30°C). Specimens for scanning electron microscopy (SEM) were prepared using the method described in Tsuneda et al. (1991).

DESCRIPTION

Eleutheromyces longispora N. Maekawa & Tsuneda, sp. nov. (Figs. 1–17)

Coloniae in PDA initio mucoideae, interdum aetate 3–5 hebdomadum partim tomentosae cum myceliis aeriis et conidiis, pycnidia tarde formantes. Pycnidia sparsa vel gregaria, in tegete mycelii semiimmersa vel immersa, subglobosa, interdum collum breve habentia, solitaria, unilocularia, glabra, 0.2–1.1 × 0.3–1.2 mm. Paries pycnidii fusco-brunneus vel ater, ca. 50 μm crassus, "textura angularis", ostiolo orbiculari centrali praeditus, ex cellulis leptodermis compositus. Conidiophora cylindrica vel leviter flexuosa, praecipue basi ramosa, peridio interno exorientia, aliquot septata, subhyalina, in muco involuta. Cellulae conidiogenae holoblasticae, cylindricae, integrae, leptodermae, laeves, cum apertura ad apicem et proxime infra quodque septum

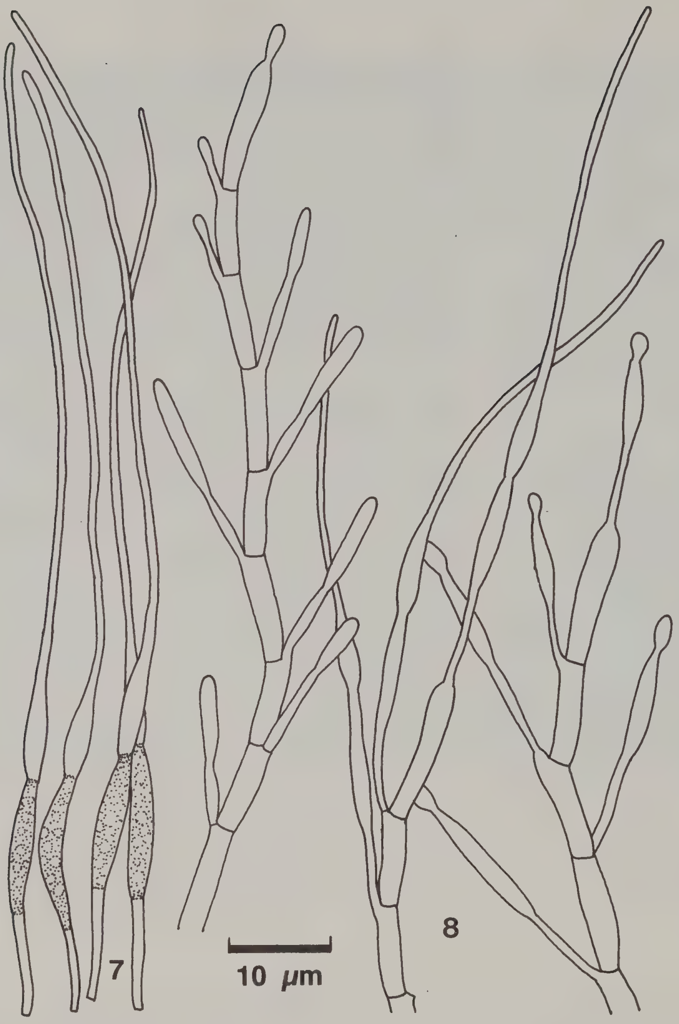


Figs. 1–6. *Eleutheromyces longispora*. 1. Pycnidia formed on PDA. 2. Vertical section of pycnidia showing ostioles (arrows). 3. Vertical section of the basal part of a pycnidium. 4 and 5. Conidiophore and pycnidial conidia (arrowheads). 6. Pycnidial conidia. Note apical (arrows) and basal appendages (arrowheads). Scale bars = 1 mm in Fig. 1; 200 μm in Fig. 2; 20 μm in Figs. 3, 5 and 6; 10 μm in Fig. 4.

praeditae. Pycnoconidia cylindrica vel anguste elliptica, aseptata, apice utrinque appendiculata, hyalina, 53.5–103 × 2–2.5 μm (cum appendicibus); appendices apicales filiformes, basi inflatae, 29–75 μm longae; appendices basales cylindricae, ad extremum truncatae, 8.5–13.5 μm longae.

Holotypus: Colonia exsiccata culturae (TMIC 33112 ex fructificatione senescenti *Trametis versicoloris* (L.: Fr.) Pilát, Shinji-cho, Yatsuka-gun, Shimane Pref. in Japonica, 20. Nov. 1995, a N. Maekawa lecta et isolata, et ea in Herbario Instituti Mycologicae Tottoriensi conservata (TMI 25000).

Pycnidia separate or gregarious, semi-immersed or immersed in the mycelial mat, subglobose sometimes with a short neck, 0.2–1.1 × 0.3–1.2 mm, dark brown to black, unilocular, glabrous (Figs. 1 and 2); pycnidial walls dark brown to black, ca. 50 μm thick, textura angularis, composed of thin-walled hyphae (Fig. 3); ostiole usually



Figs. 7 and 8. *Eleutheromyces longispora*. 7. Pycnidial conidia. 8. Conidiophores with developing pycnidial conidia.

central, circular (Fig. 2, arrows). Conidiophores arising from the inner cells of the pycnidial wall, subhyaline, branched mainly at the base, smooth, cylindrical or flexuous, with several septa (Figs. 4, 5 and 8), produced in slime. Conidiogenous cells cylindrical, 6–16 × 2–2.5 µm, thin-walled, forming conidia immediately below a transverse septum (Figs. 5 and 8). Pycnidial conidia hyaline, aseptate, cylindrical to narrowly ellipsoid with bipolar appendages, 53.5–103 × 2–2.5 µm (including the

Table 1. Pycnidial conidium dimensions (μm) of *Eleutheromyces* species

Species	Apical appendage	Main body		Basal appendage	Total length / Average (SD)	Reference
		Length	Width			
Eleutheromyces longispora	29–75	13–18	2–2.5	8.5–13.5	53.5–103 / 88.6 (10.7)	
E. mycophila	12–30	5–6.5(–10)	1.5	2–3	29.3 (average)	Nag Raj (1993)
E. subulatus	2.5–5	5–7	2–2.5	5–8	15.9 (average)	Nag Raj (1993)
TMIC32748	11–16	6.5–10	1–1.5	6–10	25.5–33.5 / 28.3 (1.6)	Tsuneda et al. (1997)
TMIC32749	5–11	5–8.5	1–1.5	2.5–8	13–24 / 19.2 (2.6)	Tsuneda et al. (1997)

appendages) (Figs. 6 and 7); apical appendages filiform with a swollen basal part, 29–75 μm in lengh (Fig. 6, arrows); basal appendages cylindrical with a truncate base, 8.5–13.5 μm in length (Fig. 6, arrowheads).

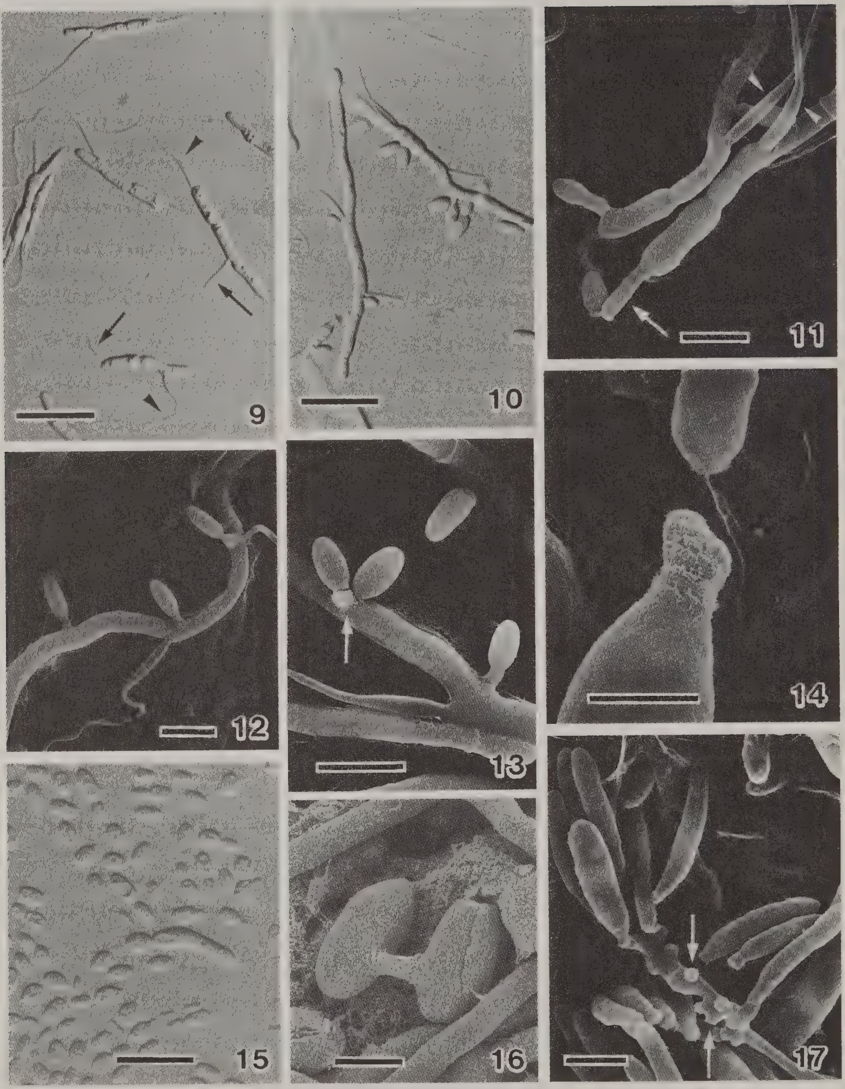
Holotype: a dried colony on PDA from TMIC33112, isolated from an old fruiting body of *Trametes versicolor*, Shinji-cho, Yatsuka-gun, Shimane Prefecture, 20 Nov. 1995, collected by N. Maekawa, deposited in TMI (TMI25000).

Etymology: "*longispora*" refers to its long pycnidial conidia.

Pycnidial conidia of *E. longispora* are 3 to 4 times longer, on average, than those of *E. mycophila* and *E. subulatus* (Table 1) and possess apical appendages with a swollen and slightly thick-walled basal part (Figs. 6, 7, 9 and 10). Such swellings do not occur in other species (Nag Raj, 1993; Tsuneda et al., 1995). On PDA, *E. longispora* produces mostly subglobose (Figs. 1 and 2) and dark brown to black pycnidia in 3 to 4 months at 21°C, whereas those of *E. subulatus* are oval, long conical or cornute and yellowish brown (Nag Raj, 1993; Tsuneda et al., 1995).

When fresh pycnidial conidia of *E. longispora* are placed on PDA and incubated at 21°C in the dark, each conidium usually swells first and becomes two-celled by forming a transverse septum before or rarely after germination (Fig. 9). Germination occurrs in either uni- or bipolar fashion from the main body (Figs. 9 and 10) within 24 hrs of incubation. In 34 to 40 hrs, conidia of the *Hyphozyma* morph develop not only from the germ tubes but also directly from the main bodies of pycnidial conidia (Figs. 11 and 12). The conidiogenesis is usually sympodial (Fig. 13), but occasionally annellidic (Fig.14). Subsequently, the conidia give rise to yeast-form cells (Fig. 15), and anastomosis sometimes occurs between adjacent cells (Fig. 16), as noted previously for the *Hyphozyma* morph of *E. subulatus* (Tsuneda et al., 1995) and in other species of *Hyphozyma* (de Hoog and Smith, 1981; Sigler, 1990).

Young colonies are mucoid on PDA, but sometimes form patches of aerial mycelium within 3 to 5 weeks. These patches become tomentose, hirsute or hispid, and contain many cylindrical conidia (Fig. 17) that were produced sympodially. These conidia secede, leaving prominent scars on the conidiogenous cells (Fig. 17, arrows). This type of conidiogenesis is unique to *E. longispora*. Unlike colonies of *E. subulatus*



Figs. 9–17. Pycnidial conidia germination of *Eleutheromyces longispora* and the *Hyphozyma* morph on PDA. 9 and 11. Germinating pycnidial conidia with germ tubes after 20 hrs. Note apical (arrowheads) and basal appendages (arrows). 10 and 12. Conidium development of *Hyphozyma* after 40 hrs. 13. Sympodial conidium formation (arrow). 14. Annellidic conidium formation. 15. Yeast-form cells of various shape and size. 16. Anastomosis tube connecting adjacent yeast-form cells. 17. Cylindrical conidia and prominent scars on a conidiophore. Scale bars = 20 μm in Figs. 9, 10 and 15; 5 μm in Figs. 11, 12 and 13; 2 μm in Figs. 14, 16 and 17.

that are characterized by the strong fragrant odor (Sigler, 1990), those of *E. longispora* are odorless.

The optimum temperature for growth of *E. longispora* is near 21°C (12.9 mm after 20 days on MEA). Growth rate of the fungus reduces considerably at a temperature between 24 to 27°C, and no growth occurs at 27°C. On the other hand, it grows well at lower temperatures: the growth rate at 4°C is about 60% of that at the optimum temperature. These features indicate that this isolate is also psychrophillic as in *E. subulatus* (Sigler, 1990; Tsuneda et al., 1995).

Acknowledgements: We thank Dr. K. Katsumoto for kindly provinding the latin description. We are indebted to Drs. S. Udagawa and Y. Hiratsuka for reading the manuscript and for their valuable suggestions.

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MYCOTAXON

Volume LXXVIII, pp. 175-180 April-June 2001

NOTES ON HYPHOMYCETES. LXXXIII. CASTANEDAEA, A NEW GENUS IN WHICH TO ACCOMMODATE ALYSIDIUM MINUS

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ABSTRACT

The anamorph currently known as *Alysidium minus* is reclassified in a new, monotypic genus, *Castanedaea*, since it is clearly not congeneric with species of *Haplotrichum*, of which *Alysidium* is now considered a synonym. This taxon differs significantly in a number of respects from any other known catenate, dematiaceous Hyphomycete. It is redescribed, illustrated, and compared with broadly similar anamorphs.

KEYWORDS: *Alysidium*, *Haplotrichum*, systematics, generic concepts.

INTRODUCTION

As alluded to previously (Partridge *et al.*, 2000, 2001), the taxonomic status of several species presently classified in *Alysidium* Kunze requires reevaluation on two interconnected accounts. Firstly, binomials in this genus are no longer nomenclaturally tenable since *Alysidium* is now considered to be a synonym of *Haplotrichum* Link : Fries. Secondly, the taxa assigned to *Alysidium* cannot be considered to be congeneric with those classified within *Haplotrichum*. Among the species currently in taxonomic limbo and needing attention are *Alysidium guttulatum* R.F. Castañeda, *A. minus* (R.F. Castañeda) R.F. Castañeda & W.B. Kendr., *A. pinarense* R.F. Castañeda & W.B. Kendr., and *A. resinae* (Fr.) M.B. Ellis. Morphologically none of these are particularly close to *Haplotrichum capitatum* (Pers.) Link, the type species of *Haplotrichum*, nor, for that matter, any other member of the genus, a number of which are known to be anamorphs of *Botryobasidium* Donk, and others assumed to be. Neither can these taxa be considered to be phylogenetically related to those species now classified in *Haplotrichum*.

An opportunity to examine the type and only collection of *Alysidium minus*, which was originally named *Cladosporium minus* R.F. Castañeda (Castañeda, 1988), has made possible further consideration of the unacceptability and inappropriateness of its current classification. This anamorph has none of the hallmark characteristics of *Cladosporium* Link, including thickened conidial scars, and, beyond the fact that conidia are produced holoblastically in short, acropetal chains, neither is it particularly similar to species of *Haplotrichum*. Moreover, this entity is uniquely different from any anamorph form-genus presently known. In view of this, a new genus is herein established in which to accommodate it.

TAXONOMIC PART

Castanedaea W.A. Baker et Partridge, gen. nov.

Coloniae hypophyllae, effusae, sparsae, pilosae, pallide brunneae. Mycelium partim superficiale sed in substrato plerumque immersum, ex hyphis ramosis, septatis, laevibus, pallide brunneis compositum. Conidophora macronemata, mononemata, erecta, simplicia, recta vel leviter curvata, cylindrica, plerumque singularia, septata, laevia, pallide brunnea vel brunnea, ad apicem pallidiora et verruculosa, ad basim inflata. Cellulae conidiogenae mono- vel polyblasticae, in conidiophoris incorporatae, terminales vel intercalares, determinatae. Conidia acropleurogena, holoblastica, in catenis simplicibus vel ramosis acropetis formata, sicca, aseptata, verruculosa vel verrucosa, ellipsoidea vel sub-globosa, pallide brunnea.

Castanedaea W.A. Baker & Partridge, gen. nov.

Colonies hypophyllous, effuse, sparse, hairy, pale brown. Mycelium partly superficial or mostly immersed, composed of branched, septate, smooth, pale brown hyphae. Conidiophores macronematous, mononematous, erect, simple, straight or slightly curved, cylindrical, mostly solitary or occasionally in pairs, septate, smooth, pale brown to brown, paler and verruculose toward the apex, inflated at the base. Conidiogenous cells mono- or polyblastic, integrated, terminal or intercalary, determinate. Conidia acropleurogenous, holoblastic, in simple or branched, short, acropetal chains, dry, unicellular, verruculose to verrucose, ellipsoid to sub-globose, pale brown.

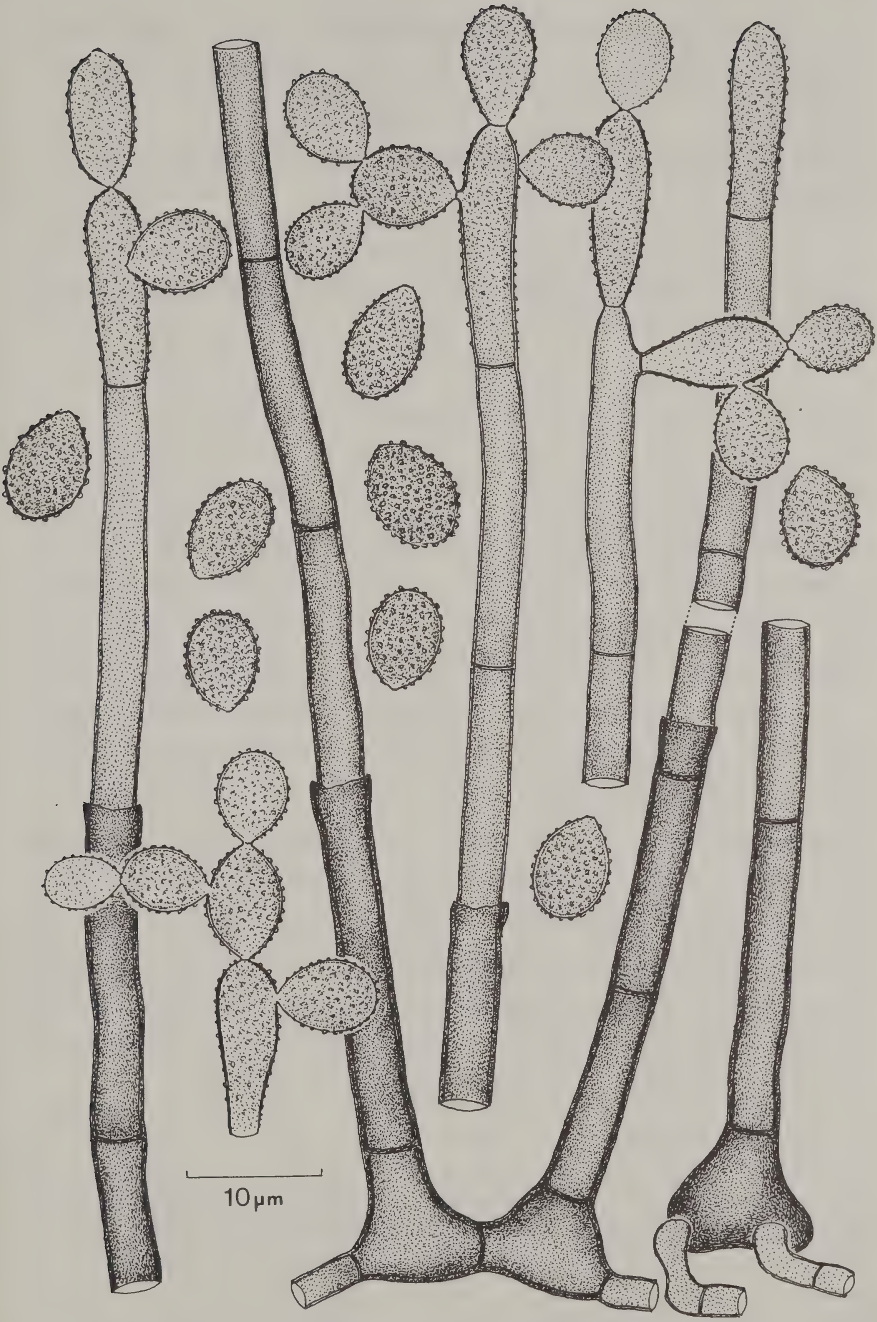

FIGURE 1. *Castanedaea minor*. Conidiophores and conidia.

Etymology: this patrilineally-derived generic name is established in honor of Dr. Rafael F. Castañeda Ruíz, who collected this anamorph, in recognition of his contributions to knowledge of Hyphomycetes.

Castanedaea minor (R.F. Castañeda) W.A. Baker & Partridge, comb. nov. (Figure 1).

≡ *Cladosporium minus* R.F. Castañeda, *Fungi Cubenses* 3:22. *Inst. Invest. Fund. Agric. "Alejandro de Humboldt"*, Havana, Cuba, 1988.

≡ *Alysidium minus* (R.F. Castañeda) R.F. Castañeda & W.B. Kendr., *Univ. Waterloo Biol. Ser.* 35:6, 1991.

Colonies hypophyllous, effuse, extremely sparse, hairy, pale brown, often barely discernible. Mycelium sometimes partly superficial, forming a thin, loose, repent network, or mostly immersed, composed of branched, septate, smooth, pale brown, 2 to 3 µm wide hyphae. Conidiophores macronematous, mononematous, erect, simple, straight or very slightly curved, cylindrical but attenuating gradually toward the distal portion, often proliferating percurrently by regenerative growth unrelated to conidiation, mostly solitary or occasionally in pairs, septate, smooth but with the terminal cell verruculose, thick-walled, thinner above a regenerative tear, pale brown to brown, with an intercalary cell occasionally darker than those adjacent, paler toward the apex, up to 200 µm long, 2 to 5.5 µm wide, distinctly inflated at the 4.5 to 7 µm wide base, giving a bulbous aspect. Conidiogenous cells mono- or polyblastic, integrated, terminal or sub-terminal, determinate; where terminal, narrowly clavate, verruculose and sometimes disarticulating, where intercalary, cylindrical, smooth. Conidia acropleurogenous, holoblastic, in simple or branched, short, acropetal chains, dry, unicellular, somewhat thick-walled when fully mature, verruculose to verrucose, ellipsoid to sub-globose, at first sub-hyaline, becoming pale brown, bearing no scar at point of detachment, 7-12 X 3-5 µm in size.

On dead leaves; Cuba.

Specimen examined: on unidentified leaf, Viñales, Pinar del Río, Cuba, R.F. Castañeda, 25 September 1987, INIFAT C87/292-2, holotype.

DISCUSSION

Castanedaea is readily distinguishable from other catenate, dematiaceous genera by a combination of characteristics. Although it has some similarity to the recently described *Websteromyces* W.A. Baker & Partridge, particularly in possessing verruculose conidia, the presence of distinctly macronematous, heavily pigmented conidiophores is a significant difference between the two. Added to that, the substrate association deviates, *Websteromyces* occurring on decorticated wood. All things being considered, there are as many distinctions between *Castanedaea* and genera of broadly similar morphology as there are similarities.

Castañeda Ruíz and Kendrick (1991) noted that *C. minor* [as *Alysidum minus*] resembles *Alysidium resinae* var. *microsporum* Sutton in conidium morphology and arrangement but differs from it in having verruculose as opposed to smooth-walled conidia. Although superficially similar, these two taxa differ also in that individual conidia are delimited in the latter by relatively wide transverse septa in contrast with the extremely narrow connectives that characterize *C. minor*. Moreover, conidium release in *A. resinae* var. *resinae* and var. *microsporum* is achieved by a schizolytic split in the delimiting septum or septa, in a manner reminiscent of *Taeniolella* S. Hughes, whereas in *C. minor* conidia are nipped off at the tenuous isthmus in a yeast-like manner. A reconsideration of the taxonomic status of *A. resinae*, as indicated above, is desirable. Among the questions that will need an answer is whether or not *A. resinae* var. *microsporum* should be accorded separate recognition at species level since it differs appreciably from *A. resinae* var. *resinae* in the morphology of its conidiophores and in the nature of its conidial chains. In addition, consideration will need to be given to an alternative classification of this species, possibly by the establishment of another new genus, since it cannot be satisfactorily accommodated in *Haplotrichum*. There exists an added complication to the taxonomy and nomenclature of *A. resinae* in that the binomial *Hormodendron resinae* Lindau was based on the same entity and is, therefore, a facultative synonym of *Myxotrichum resinae* Fr. [the basionym of *Alysidium resinae*] (Keith A. Seifert, *in litt.*). Through an unfortunate misapplication of the Lindau-authored name to another anamorph, presently known as *Hormoconis resinae* (Lindau) Arx & G.A. de Vries [≡ *Cladosporium resinae* (Lindau) G.A. de Vries] (see Ho *et al.*, 1999), the specific epithet '*resinae*', first employed by Elias Magnus Fries, is now in use for two different fungi. In other words, the name *Hormoconis resinae* is a facultative synonym of *Alysidium resinae* although it is currently applied to a different entity. Resolution of this nomenclatural and taxonomic anomaly will probably necessitate the proposing of a new name for the entity presently known as *Hormoconis resinae*, the anamorph of *Amorphotheca resinae* Parbery.

ACKNOWLEDGMENTS

We have enjoyed the benefit of consultation with Dr. Keith A. Seifert, Agriculture and Agri-Food Canada, Ottawa, concerning the nomenclatural questions surrounding use of the binomials *Alysidium resinae* and *Hormoconis resinae*, and Dr. Walter Gams, Baarn, The Netherlands, for his opinion vis-à-vis the choice of a generic name. The opportunity to examine the type specimen on which this study was based afforded by Dr. Rafael F. Castañeda Ruíz, Habana, Cuba, facilitated through the good offices of Dr. Cony Decock, Université Catholique de Louvain, Belgium, is appreciated. The manuscript was reviewed by Dr. Roger D. Goos, Department of Botany, University of Rhode Island, for which we are very grateful.

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MYCOTAXON

Volume LXXVIII, pp. 181-184 April-June 2001

A NEW SPECIES OF PHOLIOTA FROM INDIA

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Abstract: *Pholiota bambusina sp.nov.* is described, illustrated and discussed based on collections made in Kerala State, India.

Key Words: Basidiomycota, Agaricales, Strophariaceae, *Pholiota bambusina*

While studying the agaric flora of Kerala State, India, a new species of *Pholiota* (Fr.) Kummer (Strophariaceae, Agaricales, Basidiomycota) was discovered which is described below. Colour names and notations given in the description are from Kornerup and Wanscher (1978). The specimens examined are deposited at SFSU.

Pholiota bambusina K.A. Thomas & Manim. **sp. nov.**

Etymology: *L. bambusina*, belonging to bamboo.

Pileus 10-50mm latus, primo convexus, postea infundibuliformis, griseoluteus, viscidus, squamulis appressis rufobrunneis instructus. Lamellae sinuatae vel adnexae, aurantiogriseae, confertae. Stipes 15-30 x 1.5-5mm, cylindricus, pallide luteus. Odor nullus. Sapor amarus. Sporae 7-9 x 4.5-6.5μm, in cumulo luteobrunneae, ovo-ellipsoideae, raro subphaseoliformiae, laeves, cum poro germinativo indistincto. Basidia 16.5-22.5 x 7-9.5μm, 4-sporigera. Chrysocystidia 15.5-85 x 6.5-15.5μm, utriformia, marginalia et lateralia. Trama hymenophoralis regularis. Hyphae cuticulae pilei repentes, 1.5-4.5μm latae, hyalinae, in gelatino inclusae. Hyphae omnes fibulatae. Ad lignum putrescens bambusarum. Holotypus: K.A. Thomas T 215 (SFSU).

Basidiomata small to medium-sized. Pileus 10-50 mm diam., initially convex, turning infundibuliform; surface greyish yellow (4B3), greyish orange (5B3) or orange grey (5B2), with concentric zones of evenly spaced, appressed, easily removable scales which are reddish brown (8D7, 8E7, 8F7) towards centre and light brown (7D4) towards margin, viscid, inconspicuously striate towards margin when dried; margin straight to reflexed, entire, sometimes undulating. Context yellowish white. Lamellae sinuate or adnexed, orange grey (5B2) or greyish orange (5B3), crowded to subcrowded, up to 5.5 mm wide, with lamellulae of 3-5 lengths; edge pale, entire, minutely fimbriate under a lens. Stipe 15-30 x 1.5-5mm, central, terete, almost equal, solid; surface pale yellow (4A3) or light yellow (4A4), glabrous or at times with velar remnants. Odour not distinctive. Slightly bitter in taste. Spore print yellowish brown (5D6).

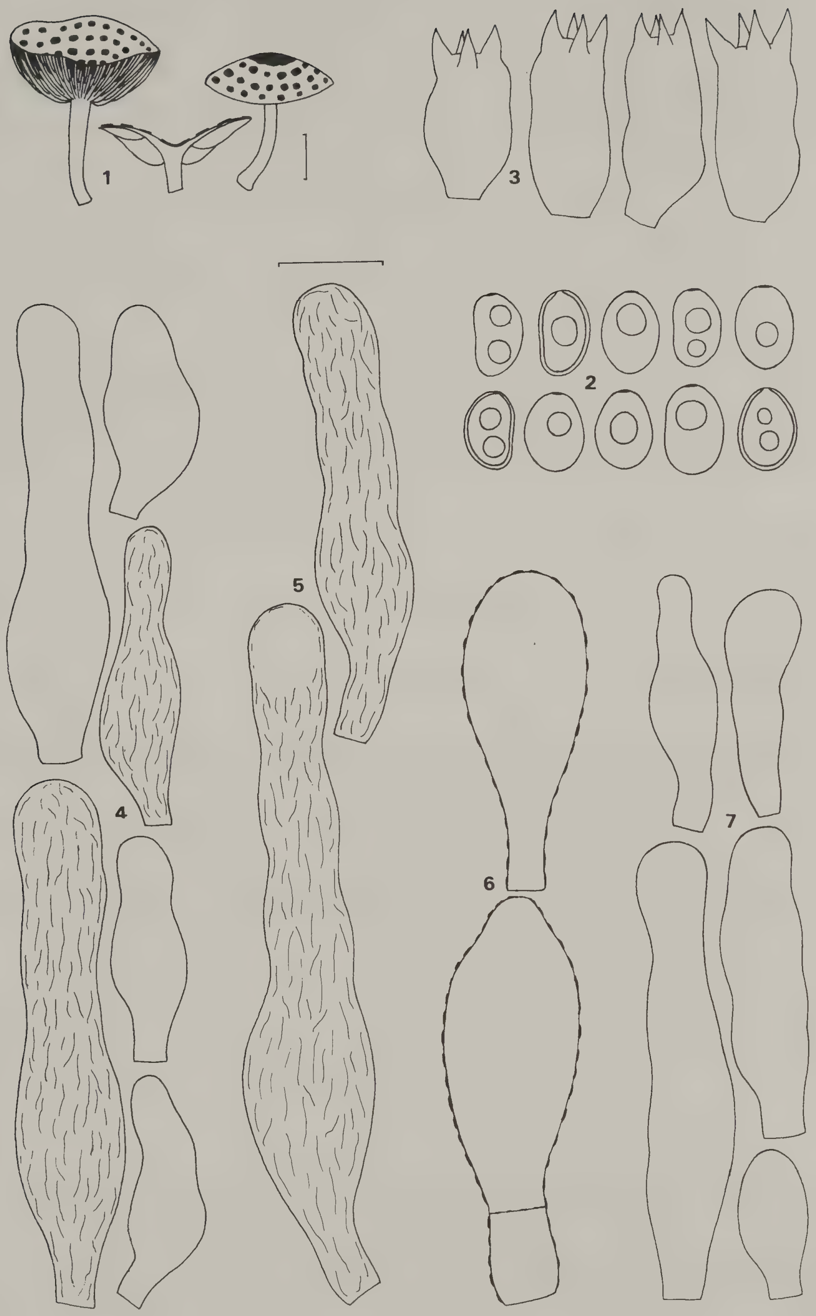
Spores 7-9 x 4.5-6.5 (8.19±0.55 x 5.27±0.50) µm, Q=1.3-1.8, Qm=1.56, mostly ovo-ellipsoid, occasionally subphaseoliform, yellowish-brown, smooth, thick-walled (about 0.5 µm), with a small apical germ-pore. Basidia 16.5-22.5 x 7-9.5 µm, clavate to cylindrical, mostly 4-spored, rarely 2-spored; sterigmata up to 6 µm long. Lamella-edge sterile or heteromorphous. Cheilocystidia in the form of chrysocystidia, 15.5-60 x 6.5-12.5 µm, conspicuously projecting, narrowly utriform or utriform, sometimes with a flexuous upper half, rarely subcapitate, thin-walled, hyaline or sometimes with light yellowish brown amorphous inclusion. Pleurocystidia in the form of chrysocystidia, 20-85 x 7.5-15.5 µm, similar to cheilocystidia in morphology, thin-walled, with yellowish brown amorphous content, rarely hyaline or pale yellowish brown. Hymenophoral trama regular; hyphae 2-22.5 µm wide, formed of short, inflated, hyaline, thin-walled cells, flanked on either side by a subgelatinzed subhymenium composed of 1.5-4.5 µm wide hyphae, loosely interwoven, thin-walled, hyaline. Pileal trama interwoven; hyphae composed of 2-21.5 µm wide, short, inflated, hyaline cells towards lower layers and comparatively long and narrow (up to 12.5 µm wide), pale brownish yellow elements towards upper region. Pileipellis an ixocutis; hyphae 1.5-4.5 µm wide, repent, thin-walled, hyaline, embedded in a gelatinous matrix above a hypodermium of non-gelatinized, yellowish hyphae with faint encrustation. Velar remnants on the pileal surface composed of 2-7.5 µm wide hyphae with yellowish brown encrustation, sometimes with cystidioid end cells, 26.5-56.5 x 9-17.5 µm, thin-walled. Stipe trama composed of 2-13 µm wide, thin-walled hyphae with a light yellow wall pigment. Stipitipellis a cutis; hyphae 2-7.5 µm wide, thin-walled, with a light yellow wall. Caulocystidia 15-52 x 5-12 µm, clavate, utriform, vesiculose or ventricose-fusoid, thin-walled, hyaline, occasional, occurring towards the stipe apex, in clusters or scattered as recurved hyphal tips. Clamp-connexions present in all parts of the basidioma.

On decaying bamboo logs, gregarious to scattered, November.

Specimens examined: India, Kerala State, Wayanad District, Ponkuzhy: 18 November 1997, K.A. Thomas T215 (holotype); 20 November 1997, K.A. Thomas T215b (all at SFSU).

This species is characterized by (1) a viscid pileus with concentric zones of easily removable, appressed scales; (2) absence of an annulus; (3) presence of conspicuous, utriform chrysocystidia on the edge and sides of lamellae; (4) ovo-ellipsoid to subphaseoliform, non-truncate, thick-walled basidiospores that are yellowish brown in deposit; (5) gelatinized subhymenium and pileipellis; (6) presence of caulocystidia; and (7) occurrence on decaying bamboo logs. Smith and Hesler's (1968) key leads to subgen. *Flammuloides* Smith & Hesler, sect. *Spumosae* Smith & Hesler, stirps *Scamba*. Within the stirps *Scamba*, there are

Figs. 1-7, *Pholiota bambusina* : 1, basidiomata; 2, spores; 3, basidia; 4, cheilocystidia; 5, pleurocystidia; 6, cystidioid end-cells of velar elements; 7, caulocystidia; scale = 10mm for basidiomata and 10µm for microstructures.



quite a few north temperate species listed by Smith and Hesler (1968) that come close to our species but none of them agrees fully with it. *Pholiota gregariiformis* (Murr.) Smith & Hesler, which seems to be the closest, has similar microscopic features including the size and shape of spores but differs in having pileal surface that is glabrous except for velar remnants on the margin, downwardly tapering stipe, thinner-walled spores and growth on soil. Size and shape of spores are very similar in the present collections and in *P. scamba* (Fr.: Fr.) Moser but the latter species has silky-fibrillose pileal surface, fragrant odour, thinner-walled basidiospores (< 0.25 µm) and growth on conifer logs and debris. *Pholiota pulchella* Smith & Hesler is similar in several characters including the thickness of spore wall, but has slightly shorter and broader basidiospores, cystidia with acute apex, olive to green tones in all parts of the basidiomata and association with conifer debris and humus. *Pholiota bambusina* is similar to *P. peleae* Horak & Desjardin described from the Hawaiian Islands (Horak, Desjardin & Hemmes, 1996) in several macro- and microscopic features. *Pholiota peleae*, however, differs in the following features: obtusely umbonate pileus, stipe with numerous coarse white rhizomorphs, nongelatinized subhymenium, absence of caulocystidia, and growth on moss-covered branches of dicot trees and tree ferns.

ACKNOWLEDGMENT

We thank Dr. D.E. Desjardin (SFSU) for a presubmittal review of the manuscript.

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MYCOTAXON

Volume LXXVIII, pp. 185-189 April-June 2001

DICTYOSPORIUM TRIRAMOSUM, A NEW HYPHOMYCETE FROM ARGENTINA.

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ABSTRACT

Dictyosporium triramosum sp. nov. is described from fallen, decaying herbaceous stem, floating in polluted water from Santiago river (Bs. As. Province, Argentina). It is sporodochial and characterized by conidia consisting of three parallel rows, tightly appresed arranged in three planes. *Dictyosporium triramosum* is compared with other *Dictyosporium* species of similar conidial morphology.

Key words: *Dictyosporium*, Hyphomycetes, litter.

INTRODUCTION

The genus *Dictyosporium* was erected by Corda (1836) to accomodate *D. elegans* with cheiroid conidia (Ellis 1971). Recently, T. Goh et al.(1999) described *D. giganticum, D. nigroapice and D. tetraseriale* and this fact brought the total number of species accepted in *Dictyosporium* to 24. Among them it is possible to distinguish two different types of conidia: **a.**- with cell rows arranged in one plane and **b.**- with the cell rows arranged in two or more planes. *D. alatum* v. Emden, *D. brahmaswaroopii* Mehrotra, *D. bulbosum* Tzean & Chen, *D. campaniforme* Matsushima, *D. crustaceum* (Karst.) Hughes, *D. digitatum* Chen, Awang & Tzean, *D. elegans* Corda, *D. foliicola* Kirk, *D. nigroapice* Goh, Hyde & Yanna, *D. polystichum* (Hohnel) Damon, *D. salami-sharma* Munjal & Jandaik, *D. schizostachyfolium* Bat. And Farr, *D. tetraseriale* Goh, Hyde and Yanna, *D. toruloides* (Corda) Gueguen, *D. triseriale* Matsushima, *D. zeylanicum* Petch are included in the first group of conidial types and *D. australiense* Sutton, *D. cocophilum* Bat. *D. gauntii* Bhat & Sutton, *D. heptasporum* (Garavaglio) Damon, *D. micronesicum* Matsushima, *D. oblongum* (Fuckel) Hughes, *D. subramanianii* Sutton are included in the second group of conidial types to which we add *D. triramosum* here described. Among these species only *D. gauntii* Bhat & Sutton and *D. oblongum* (Fuckel) Hughes have not a sporodochial arrangement.

TAXONOMY

Dictyosporium triramosum Arambarri, Cabello & Cazau sp. nov. Fig.1-6
Etym.: *triramosum*, referring to the three rows of cells of the conidium.

Coloniae in vitro post 30 dies 20-25 mm, effusae, *sporodochis* abundantibus, flavido-brunneae, vel atro-brunneae, dispersae in centralibus areis, vel zonatae. *Mycelium* fere

inmersum, partim superficiale album, griseo-album; ex hyphis ramosis, septatis, laevibus, hyalinis vel brunneis, 3-4 µm latum, compositum. Solubile pigmentum pallidum flavum vel leviter luteum, reversum luteo aurantiacum vel flavido-brunneum. *Conidiophora* micronematosa, simplicia, laevia, hyalina vel brunnea. *Cellulae conidiogenae* in conidiophoris incorporate vel discretae, hyalinae vel brunneae, cylindricae, doliiformes, subglobosae, laeves, 8.1-9 x 4-5.1 µm. *Conidia* solitaria, holoblasticae, pallide brunneae vel atrobrunnea, glabra, 40-60 x 10-13.5 µm, cum plus minusve triangularibus basilaribus cellulis et tribus paralleles interse adpressis composita, omnia branchia cum usque ad 9-10 septa, cellulae terminalis hyalina, incurva. Sporodochia usque ad 200 µm lata.
Holotypus in caulis dejectis, Rio Santiago, Buenos Aires, Argentina, Mar. 1999, Arambarri et al., LPS 45524; LPS culture collection # 617.

Colonies on natural substratum consisting of septate, branched dark brown mycelium and abundant light brown sporodochia. *Sporodochia* scattered, globose, subglobose or irregularly shaped, up to 200µm. *Conidiophores* micronematous, simple or with few branches, flexuous, smooth, hyaline to brown up to 4 µm long. *Conidiogenous cells* integrated or discrete, globose to subglobose, thin walled, smooth, hyaline or light brown, 8.1-9 x 4-5 µm. *Conidia* solitary, dry, holoblastic, cheiroid, yellow brown to brown, smooth, 40-60 µm long and 10-13.5 µm wide, with a more or less triangular basal cell, 4.5-5.1 µm wide, from which 3 (ocasionally 2) parallel, appressed rows of cells, arise, arranged in two planes, each row with 9-10, thick walled cells of 3-3.5 µm long and 5-5.5 µm wide, terminal cells distinctly, hyaline, thin walled, lightly incurved, 5-5.5 µm long and 4.8-5 µm wide. Total number of conidial cells 26-30.

Colonies on CMA diameter 20-25 mm at 21 d., effuse, *sporodochia* abundant, yellow to light brown, scattered in central area, or zonate with 1-3 circles in submargin, up to 200 µm wide. *Mycelium* mostly submerged, partly superficial, composed of branched, septate, smooth, brown to dark brown hyphae, 2-4 µm wide; soluble pigment pale yellow to lightly yellow; reverse colourless, yellow to yellow brown. *Conidiophores* micronematous, simple or irregularly branched, flexuous, smooth, light brown. *Conidiogenous cells* integrated or discrete, hyaline to brown, doliiform, subglobose, thin walled, smooth, hyaline to light brown, 7.5-8 x 4-4.5 µm. *Conidia* solitary, holoblastic, cheiroid, yellow brown to brown, smooth, 45-62 µm long and 10- 13.5 µm wide, with a more or less subconic basal cell, 4.5-5 µm wide, on which 3 parallel (ocasionally 2) appressed rows of cells arise, arranged in two planes, each row with 8-10, thick walled cells of 2.7-3µm long and 5-5.5µm wide; terminal cells distinctly, hyaline thin walled lightly incurved 5-5.5 µm long and 4.8-5 µm wide. Total number of conidial cells 26-30.

The three rows of cells arranged on two planes represent the most remarkable morphological feature of *Dictyosporium triramosum*. Each row contains 9-10 thick walled, light brown cells with the terminal cell hyaline, thin-walled and slightly incurved. This species is close to *Dictyosporium australiense* Sutton and *D. micronesicum* Matsushima (1981) due to its number of rows cells and conidia shape . *D. australiense* is also composed of three rows of cells, but the whole sporodochium of conidium is embedded in a gelatinous matrix and the conidia is smaller than the conidia of *D. triramosum.* Our new species has sporodochia similar with *D.micronesicum,* but they differ in conidia size. *D.micronesicum* has 2-5 (usually 4) branches with 5-7 cells each. The species we are describing has 3 branches (rarely 2 and never 4), with 9-11 cells each. Also its size is different: *D.micronesicum* is smaller (20-30µm long and 10-12 µm wide) than D. *triramosum.*

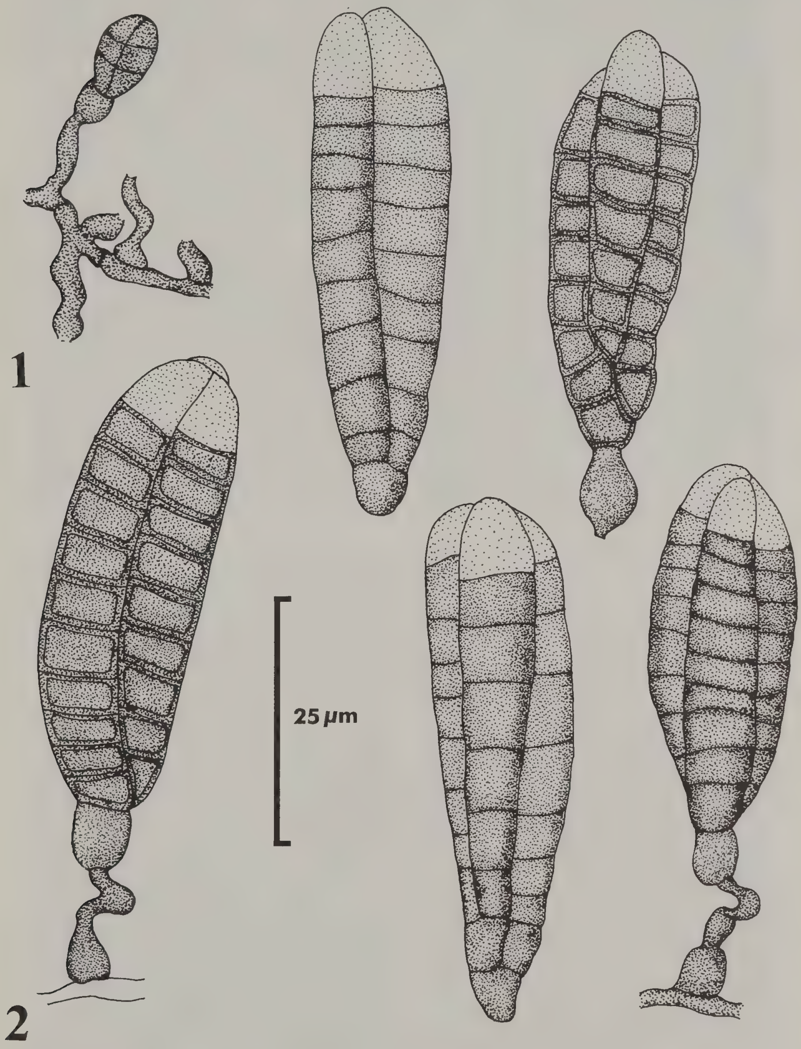
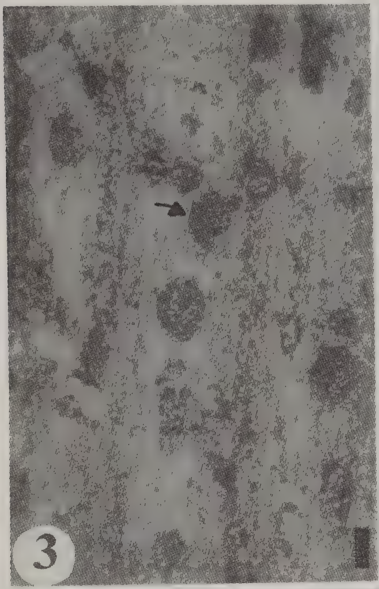
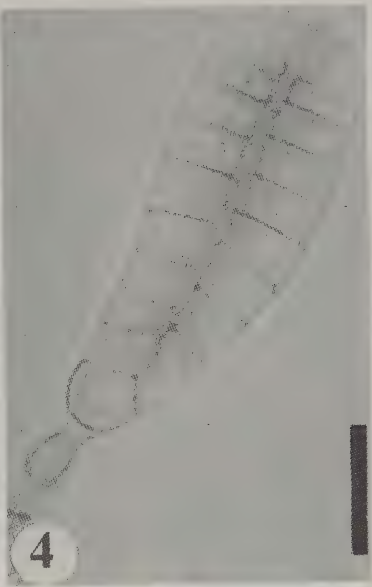
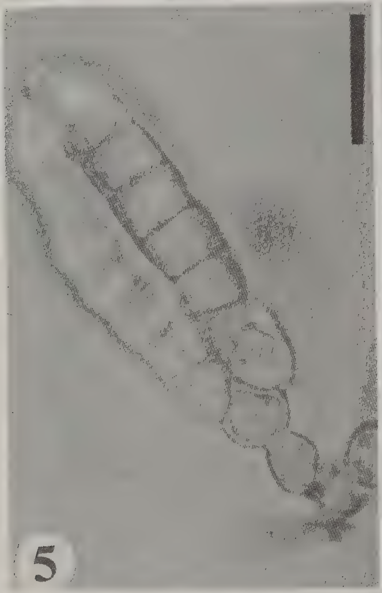


Fig.1. Detail ofconidiogenous cells and conidium on natural substrate.
Fig.2. Conidium on culture media.Bar = 25 µm







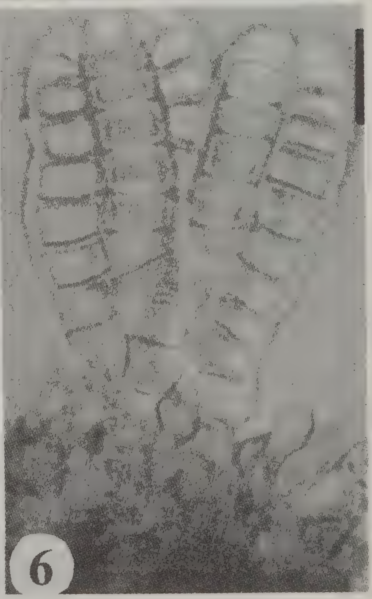


Fig. 3. General aspect of the sporodochia on litter. Bar= 0.16 mm
Fig. 4-6. Detail of the conidium and conidiogenous cells. Bar= 10μm

ACKNOWLEDGEMENTS

We thank Dr J.E. Wright and Dr I. J. Gamundí for reviewing the manuscript. H. Spinedi is thanked for the photographs, he is Technical Assistant of Comisión de Investigaciones Científicas and N. Malacalza for inking the drawings. A. M. Arambarri is researcher of National Research Council; M. N. Cabello is researcher of Comisión de Investigaciones Científicas and M. C. Cazau is researcher of the University of La Plata. This work was funded by CONICET.

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MYCOTAXON

Volume LXXVIII, pp. 191-244 April-June 2001

CHOROLOGIC DATABASE OF EUROPEAN RHIZOPOGON SPECIES

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Abstract. After examining 2495 herbarium samples, 22 species are accepted in Europe. *Rhizopogon luteolus* (for which a neotype is designated), *R. marchii, R. occidentalis* and *R. roseolus* are widely distributed in Europe. In the Iberian Peninsula, *R. luteolus* was collected along the coast. The only species with an Atlantic distribution is *R. ochraceorubens.*

Keywords: Basidiomycotina, hypogeous fungi, distribution, ecology.

Introduction

The purpose of this paper is to give the data included in each herbarium from collections examined during the elaboration of the monograph "The *Rhizopogon* species in Europe" (MARTÍN, 1996) and MARTÍN & CALONGE (2000). The species have been arranged in alphabetical order and include species treated in MARTÍN (1996), as well as species not located in Europe that were studied for comparison. The large number of collections of *R. roseolus* (Corda) Th. M. Fr. have been listed under five groups (A,B,C,D and E), according to their spore volume (GROSS et al., 1980; MARTÍN, 1996).

In each species, European collections are listed first, followed by non-European (extralimital) ones. Countries are arranged in alphabetical order, the boundaries of which have been updated (NAVARRO, 1993). In each country, entries have been arranged by our register number and include literal transcription of the herbarium labels. The symbol "*" after the register number means that this collection is conserved in formaldehyde and not dried.

Information is given in the following order: the locality, habitat and altitude above sea level (when available), date of collecting, collector ("leg." is inserted before the name or names of collectors), indication of type material, identification if incorrect or misleading (samples undetermined will not be indicated), name and number of the exsiccati between parentheses and finally, herbarium where collection is deposited (abbreviated according to HOLMGREN et al., 1990) with indication of duplicate or slide in our herbarium (BCC). Any additional information not written on the label is given between brackets.

At the end of the list for each country, collections with a vague indication of the locality (only information about the province or a large geographical area) or that we have not located on a map are indicated with the symbol"#". Collections without data about locality, with illegible handwriting or uncertain decipherement (?) are arranged in numerical order after the extralimital collections. Collections with material in bad condition and not identified are given at the end of the appendix, arranged first by countries and then by the register number.

List of collections examined

Rhizopogon abietis A.H. Smith

European collections. **AUSTRIA**: 744.- Tirol, Walweg zw., Sellrain und Gries, Sellraintal, unter *Picea*, hypogäisch, 4.7.1987, leg. M. Moser (IB, slide BCC-MPM 2121). **DENMARK**: 745.- Sjælland, EnØ, Klintegårdsvej 211, under *Pinus*, clavely and rather rich soil, 17.8.1974, leg. H. Dissing as *R. luteolus* Fr. (C, slide BCC-MPM 2120). **FRANCE**: 750.- Macôt, Savoie, *Picea*, *Larix*, quelques feuillus, 1600 m, 25.8.1988, leg. M. Meyer (G 15755, slide BCC-MPM 2178). **ITALY**: 749.- Cavelonte, subterraneus in silvis conifery, 1898, leg. Bresadola as *R. virens* Alb. & Schw. (S); 2347.- Boschi nei dintorni di Bormio (SO) nela Valtellina sulle alpi, affiorante dal terreno in bosco di abete rosso e pino silvestre, 1200 m, 16.8.1989, leg. G. Imperatori (Sarasini 357, duplex BCC-MPM 1868). **SPAIN**: 730.- Lleida, La Seu (Alt Urgell), CG67, 1550 m (BCC-MPM 110); 739.- Girona, Ermita de Sant Grau, Urùs (Cerdanya), DG08, 1300 m, *Pinus sylvestris*, calcáreo, 10.10.1985, leg. MPM (BCC-MPM 530); 2399.- Girona, leg. J.M. Vidal (BCC-MPM 1808); 2401.- Girona, 5.12.1988, leg. C. Ginés (BCC-MPM 1810); 2430.- Girona, leg. J.M. Vidal (BCC-MPM 1837); 2446.- Tarragona: Ermita de Sant Miquel, l'Espluga de Francolí (Alt Camp), 12.10.1994, leg. R.Mª Alentorn (BCC-MPM 1872). **SWEDEN**: 746.- Västmanland, Tillberga, Ångloksgatan 16, I trädgrård under tall, nära ytliga rötter, 14.6.1987, leg. H. Kaufmann as *R. luteolus* Fr. (S); 747.- Uppland, Uppsala, Forest city, side of a path under *Abies alba*, 19.8.1992, leg. MPM (BCC-MPM 1557); 748.- Västmanland, Västerås-Barkarö, Socken, Fullerö, I gräsmatta, 17.9.1980, leg. H. Kaufmann (S).

Extralimital collections. UNITED STATES: 743.- Idaho, Near Stanley, Custe Co., under *Pinus contorta*, leg. K.A. Harrison 6174 (UPS, slide BCC-MPM 2000); 2346.- Idaho: Heaven's Gate, Seven Devils Mountains, Idaho Co., 11.8.1964, leg. A.H. Smith 69834, PARATYPE (E).

Rhizopogon angustisepta Zeller & Dodge

European collections. **GERMANY**: 2357.- Wm. Krüger, Lloyd Mus. 6692, ex Zeller Herb. 1437, HOLOTYPE (NY).

Rhizopogon aromaticus Calonge & M.P. Martín

European collections. **SPAIN**: Ciudad Real, Viso del Marqués, Valle de los Perales, aggregate under *Pinus pinea*, *Quercus faginea* and *Cistus monspeliensis*, 7-XII-1997, leg. F.D. Calonge (MA-Fungi 40582).

Rhizopogon aurantiacus A.H. Smith

European collections. **SWEDEN**: 751.- Uppland, Lena Park, Hummeltorp, in sand under *Pinus sylvestris*, 2.9.1992, leg. S. Rymann (BCC-MPM 1560).

Extralimital collections: UNITED STATES: 2561.- Idaho,Twenty-Mile Creek, Upper Payette Lakes, Valley Co., 18.8.1964, leg. A.H. Smith 69546, HOLOTYPE (MICH).

Rhizopogon corsicus Moyersoen & Demoulin

European collections. **BELGIUM**: 758.- Zutendaal, près des carrières Liebens, dans les sables, bord de Sentier, 17.9.1989, leg. V. Wierzhicki (LG, slide BCC-MPM 1296). **FRANCE**: 757.- Corse, Fôret de Valdoniella, près de la maison forestière de Popaja, sous *Pinus laricio*, UTM MM9381, 1075 m, 2.7.1988, leg. V. Demoulin 7172, PARATYPE (LG, slides BCC-MPM 1295A y 1295B); 2434.- Corse, Fôret de Zonza, 3.4 Km ap. le village sur la route de l'Ospédale (RF11), sous *Pinus pinaster*, UTM NM12, 41.4N/9.1 E, 750 m, 15.10.1972, leg. V. Demoulin 4580, ISOTYPE (BCC-MPM 1984). **SPAIN**: 759.- Girona, Carretera de la Bisbal a Caça de la Selva (La Selva), pinar, 14.10.1988 (BCC-MPM 1037); 1009.- Barcelona, Seva (Osona), bosque *Pinus sylvestris*, 10.1991, leg. M. Tabarés (BCC-MPM 1471); 2161.- Madrid, Carretera de

Madrid a Colmenar viejo, finca "Tres cantos", 3.11.1972, leg. F.D. Calonge, as *R. luteolus* Fr. (MA-Fungi 4177).

Rhizopogon ellenae A.H. Smith

European collections. **SPAIN**: 2151.- León, Tabuyo del Monte, bajo *Pinus pinaster*, leg. J.C. Santos, 1.12.1991 (BCC-MPM 1693).

Extralimital collections. UNITED STATES: 2270.- Idaho, Above stolle Meadows, Boise National Forest, Valley Co., 29.8.1958, leg. A.H. Smith 60676, PARATYPE (UPS, slide BCC-MPM 2008.1); 2271.- Washington, Trout Lake campground, Klickitat Co., under pine at edge of woods, 3.10.1964, leg. Owalds, PARATYPE (UPS, slide BCC-MPM 2008); 2322.- *Idem* (E). 2272.- California, Mendocino Co., 5 mi E of Mendocino, hypogeous under *Pinus muricatus*, 4.12.1971, leg. J. Trappe 3103 (LG); 2441.- *Idem* (M, slide BCC-MPM 2112).

Rhizopogon evadens A.H. Smith

European collections. **FRANCE**: 762.- Corse, près de la gare de Vizzavona, sous *Fagus* et *Pinus nigra* ssp. *laricio*, UTM NM16, 900 m, 9.10.1972, leg. Demoulin 4509 (LG, slide BCC-MPM 1309); 763.- Corse, forêt de Zonza, env. 5 km ap de village sur la route du col de Bavella, forêt mélangée de *Pinus nigra* ssp. *laricio* et *Pinus pinaster* sur sol granitique, UTM NM12, 950 m, leg. Demoulin 4576 (LG , slide BCC-MPM 1310); 764.- *Ibidem*, 3.4 km ap le village sur la route de l'Ospédale (RF 11), sous *Pinus pinaster*, UTM NM12, 750 m, 15.10.1972, leg. Demoulin 4579 (L, slide BCC-MPM 1311); 765.- *Idem*, leg. Demoulin 4580 (L, slide BCC-MPM 1312).

Extralimital collections. UNITED STATES: 646.- Oregon, Hood river County, Tilly Jane Forest, hypogeous under *Tsuga mertensiana*, 5.700 ft a.s.l., 17.9.1970, leg. W. & E. Weygandt ex Herb. Trappe 2237, as *R. evadens* A.H. Smith var. *subalpinus* A.H. Smith (BP 48982); 766.- *Idem* (PR 721453); 761.- Idaho, Idaho Co, Northwest of Burgdorf, under lodgepole pine, 13.8.1958, leg. Smith 59986 as *Rhizopogon evadens* A.H. Smith var. *evadens* (UPS, slide BCC-MPM 2007); 2353.- Idaho, Toller's Ditch, Burgdorf, Idaho Co., 7.8.1964, leg. A.H. Smith 68980, PARATYPE of *R. evadens* var. *evadens* (MICH).

Rhizopogon fuscorubens A.H. Smith

European collections. **SPAIN**: 2156.- Lugo, Folgoso do Couvel, Vilar, 29TPH 4512, 26.10.1984, leg. F.D. Calonge (MA-Fungi 7988); 2157.- Ávila, El Tiemblo, 27.10.1982, leg. F.D. Calonge (MA-Fungi 4927).

Extralimital collections. UNITED STATES: 768.- Massachussetts, Franklin Co., Deerfied, Long Plain Road, Sandy Pine Barrens, Whately/So, erumpent from sandy soil, in the open, near *Pinus rigida*, 9.10.1983, leg. R.E. Halling & B.M. Thiers 3700 (LUND); 769.- *Idem* (H); 2359.- *Idem* (NY); 770.- *Ibidem*, 11.10.1982, leg. R.E. Halling 3556 & B.M. Thiers (H); 2360.- *Idem* (NY); 2312.- Oregon, Multonah Co., Oregon Mycological Society Show, 11.10.1964, leg. A.H. Smith 71172, PARATYPE of *R. fuscorubens* A.H. Smith (MICH, slide BCC-MPM 2198); 2361.- Oregon, Lane Co., 4 mi. N. of Florence at Indian Village, under *Pinus contorta* and *Picea sitchensis* on sand, 10.10.1976, Leg. J. Trappe 4751 (NY).

Rhizopogon luteolus Fr. & Nordholm

European collections. **AUSTRIA**: 328.- Lienz, sablonneux, bois de sapin, 1856, leg. Desmazières (G); 352.- Tirol, Obsteig, Mieminger Hochebene, 1927, leg. V. Litschauer (W); 353.- Leutasch, am Weidachersee, am Rande eines Föhrenwaldes: halbunterirdisch, 20.8.1933, leg. V. Litschauer (Litschauer, Fungi Tirolenses exsiccati 224) (W); 356.- Tirolia, in silvis ad Jenesien prope Bozen, m. Sept. leg. F. de Höhnel (Höhnel, Kryptogamae exsiccatae 1607) (W); 391.- *Idem* 356 (JE); 397.- *Idem* (PC); 436.- *Idem* (H); 357.- Tirol, Obsteig, Mieminger-Platte, Jm Nadelwald, mit dem Scheitel aus dem Boden hervorragend, 20.8.1927, leg. V. Litschauer (Litschauer, Fungi Tirolenses exsiccati 93) (W). **BELGIUM**: 16.- Hechtel (Linbourg), dans les sables, sous les mousses, 6.11.1977, leg. J. Damblon (LG, duplex BCC-MPM 1391); 17.- *Ibidem*, dans le sables sous les pins, leg. J. Damblon (LG, slide BCC-MPM 1392); 20.- *Ibidem*, bois de pins sur sable, 29.9.1974, leg. J. Damblon (LG, slide BCC-MPM 1395); 22.- *Ibidem*, a demi enterré dans le sable, sous les pins, 23.10.1966, leg. V. Demoulin (LG, slide BCC-MPM 1393); 23.- *Ibidem*, pinède sur sable, 9.10.1968, leg. V. Demoulin (LG, slide BCC-MPM 1394); 59.- Dans les bois de sapins des Flandres, surtout ceux où le sol est sablonneux (Westend. Herb.-Cryptog. 39) (PAV); 68.- *Idem* (PAD); 61.- Sapinières des environs d'Anvers, dans la Campine, 9.1882, leg. E. Bommer & M. Rousseau (Roumeguère, Fungi Gallici Exsiccati 2316) (PAV); 302.- *Idem* (BP); 329.- *Idem* (G); 376.- *Idem* (CUP); 398.- *Idem* (PC). **CZECH REPUBLIC**: 3.- Ad Pragam, 8.1926, leg. Zíta, TYPE of *Rhizocarpon reticarpus* Vel. (= *rhizophorus* Vel.) (PRM 619010, slide BCC-MPM 2183); 74.- Bohemia merd., Blatna, marginem arenosum, 20.6.74, leg. A. Vimikovc (PRM); 334.- Bohemia, Frávcice prope Litoměřice, in pineto, 8.8.1948, leg. Vách. Fryner (PRM, 619020); 337.- Bohemia, z poradny na Vinohradech v Praze, 9.1966 (PRM 625112). **DENMARK**: 111.- Sjælland, Uylland Ho plantage, in sandy soil under *Pinus sylvestris*, half buried, 22.10.1975, leg. H. Knudsen (C); 112.- Nordjylland, Klitmøller i Thy, 22.10.1980, leg. P. Jeppesen (C); 113.- Råbjerg Mile, 5.10.1950, leg. M. Lange 3399 (C); 114.- *Idem*, leg. M. Lange 3397 (C); 115.- *Idem* (C); 117.- *Idem*, leg. M. Lange 3398 (C); 116.- Jylland, Pine forest near Nordby, Fanø, UTM 156 H5, 20.10.1965, leg. K. Rasmussen (C); 118.- Jylland, Skramsø Plantage på Djursland, 21.9.1979, leg. H. Folkmar (C); 119.- Jylland, Skagen Klitplantage, 23.10.1959, leg. A. Haubach (C); 120.- Jylland, Rind Plantage, syd for Herning, 20.10.1981, leg. Klug-Andersen (C); 121.- Jylland, Vejers plantage, along sandy path in plantation with *Pinus sylvestris*, 21.10.1975, leg. H. Knudsen (C); 122.- Sjæland, Asserbo Plantage, along path in plantation with *Pinus* sylvestris and *Picea abies*, 1.10.1975, leg. H. Knudsen (C); 123.- Jylland, Rømø, near Tvistmark, 17.10.1963, leg. I. Weng & J.P. Jense (C); 124.- Jylland, Tved Plantage, under *Pinus*, 17.10.1974, leg. D. Boertmann (C); 127.- *Ibidem*, along path in plantation of *Pinus sylvestris*, 19.10.1980, leg. P. Rabenborg (C); 125.- Jylland, Ho plantage ved Varde, common in the plantation on sandy soil, usually with the top of the truffle at soil, 18.10.1968, leg. B. Hansen (C); 126.- Jylland, Anholt, UTM 156 E 8, under *Pinus mugo*, 5.8.1977, leg. D. Boertmann (C); 128.- Jylland, Ål Plantage, Oksbøl, vest for Varde, on poor, sandy soil under *Pinus mugo*, 25.10.1975, leg. H. Knudsen (C); 129.- Nordjylland, 3 km vest for Bulbjerg, leg. A.R. Andersson (C); 130.- Nordjylland, Svinkløv Plantage, under *Pinus* på sandbund, 29.10.1977, leg. H. Knudsen (C); 131.- Nordjylland, Hurup Sande, under *Pinus*, 18.9.1977, leg. H. Knudsen (C); 132.- Nordjylland, Bunken Klitplantage, 10.1962, leg. A. Hauerbach (C); 242.- Jylland, Skagen, Råbjerg Mile, sand dunes, along roots of *Pinus*, 24.9.1988, leg. M. Jeppson 2670 (UPS). **ESTONIA**: 371.- Põlva, Taevaskoja, ad terram in Pinetum, 31.8.1968, leg. H. Trars, as *R. vulgaris* (TAA). **FINLAND**: 53.- Nylandia, Helsingfors, 1888, leg. Elfving (UPS); 237.- Åland, Mariehmn, Ylternäs, 8.1905, leg. M. Brändström (UPS); 255.- Nylandia, Hanko commune, Syndalen, Grid 27°E 664:28, dunes under *Pinus sylvestris*, 12.9.1964, leg. M. Eriksoon (TUR 27693); 259.- *Idem* (TUR 27691); 260.- *Idem* (TUR 27690); 265.- *Idem* (TUR 138); 256.- Nylandia, Hanko commune, Henriksberg, Grid 27°E 664:28, on sandy soil, near *Cladina rangiferina* and *Festuca polesica*, 11.9.1964, leg. M. Eriksson (TUR 27696); 257.- Satakunta, Yyteri, Grid 27°E 282:20, dunes 2 m of *Pinus sylvestris*, near *Cladonia cornuta*, *Polytricum*, *Festuca rubra* and *Leymus arenarius*, 28.8.1962, leg. M. Eriksson (TUR 27692); 261.- *Idem* (TUR 27688); 258.- Ostrobottnia borealis, Rovaniemi rural commune, Ojanperä, Grid 27°E 737:43, 10.9.1969, leg. E. Kankainen (TUR 16633); 262.- Nylandia, Hanko commune, Storviken, Grid 27°E 6641: 271, dunes, 8.1965, leg. M. Eriksson (TUR 27694); 263.- Ostrobottnia australis, Lapua commune, the hill Simsiönvuori, 27.9.1969, leg. V. Arnala (TUR); 264.- Nylandia, Hanko commune, Tvärminne, Grid 27°E 664: 28, dunes under *Pinus sylvestris*, 19.9.1970, leg. M. Eriksson (TUR 13720); 364.- Ostrobottnia media, Kokkola, grid 27°E 7094:310 dry meadoow on sandy ground with pines and grey alder (*Pinus sylvestris* and *Alnus incana*), 11.9.1981, leg. R. Storbacka as *R. vulgaris* (Vitt.) M.Lange (OULU); 365.- Nylandia, Hanko, Tvärminneby, Grid 27° E 6643:287, pine forest on dunes W of football field, in sand, 18.9.1979, leg. T. Ulviden (OULU); 366.-

Regio kuusamoënsis, Kuusamo, Oulanka national park, S slope of Ampumavaara, Grid 27° E 7366:603, alt. 180 m, mixed pine dominated forest, 20.8.1983, leg. A. Markkola (OULU); 368.- Regio kuusamoënsis, Kuusamo, Oulanka national park, near the biological station, Grid 27°E 7366:603, 7.8.1976, leg. E.B. Hansen (OULU); 369.- Regio kuusamoënsis, Posio, Livojärvi, lower S slope of hill Kiurusenvaara, paludified eutrophic mixed forest (*Picea, Pinus, Juniperus, Salix*), under *Juniperus* in moss (*Sphagnun warnstorfii*, *Rhytidiadelphus triquetrus*), several large groups, Grid 27° E 7324:555, 275 m, 5.8.1979, leg. T. Ulvinen (OULU); 370.- Karelia borealis, Lieksa, Patvinsuon national park, sandy shore of the lake Suomujärvi, Grid 27°E 7008:688, 21.8.1984, leg. K. Salo (OULU); 428.- Nylandia, Helsinki, Kallvikudden, Grid 27°E 6676:397, hiekkaranta, dyyni (*Pinus sylvestris*, *Calluna vulgaris*), 6.8.1977, leg. R. Saarenoksa (H); 429.- Nylandia, Borgå landskom, Pellinge, Stor Pellinge, Ölandet, 1937, leg. R. Bäck (H); 430.- Nylandia, N. Helsingfors, Granö, 22.8.1922, leg. E. Aspelin (H); 432.- *Idem* (H); 431.- Nylandia, U. Helsinki, Vuosaari, Kallvik, männikkö, 13.9.1967, leg. R. Fagerstén (H); 433.- Nylandia, N. Helsingfors, 1941, leg. F. Hisinger (H); 434.- Nylandia, N. Hangö, Tvärminne, Spängren, 13.8.1937, leg. A.-M. Malmström & E. Häyrén (H). **France**: 7.- Jarzé, Pinus, sol sableux, 20.11.1983, leg. J. Mornand 8305 G (duplex BCC-MPM 1722); 8.- Corse, Fôret de Calenzana près de Calvi, Cirque de Bonifato, alt. env. 700-800 m, semi-hypogé dans un maquis haut avec *Buxus*, présence de *Pinus nigra* sp. *laricio* à distance, 13.6.1982, leg. V. Demoulin 6359 (LG, slide BCC-MPM 1297); 9.- Corse, dunes côtières de la baie de Calvi, un peu à l'E. de la ville, UTM MN81, 42.2 N/8.4 E, dunes plantées de *Pinus pinaster* et *Pinus pinea*, zone un peu humide (joncs), 6.10.1972, leg. V. Demoulin 4476 (LG, slide BCC-MPM 1298); 10.- Maine-et Loire, Saint Lambert La Potherie, UTM XT 3, bois mélés, 15.10.1976, leg. J. Mornand 155 (LG, slides 1382 A and 1382 B); 13.- Chaumant d'Anjou, UTM YT1, sous pins, 27.10.1979, leg. J. Mornand 239 (LG, slide BCC-MPM 1384); 14.- L'E de Sovesmes (Loir-et-Cher), près de Salbris, sous pins, 10.6.1979, leg. J. Mornand 259 (LG, slide BCC-MPM 1385); 15.- Parc d'Ovion, UTM YT2, sables argileux, pins, 23.9.1979, leg. J. Mornand (LG, slide BCC-MPM 1386); 21.- Landes, dunes au N de Mimisan-Plage, Forêt de Sainte-Eulalie, dispersés sous *Pinus maritima*, 25.10.1968, leg. V. Demoulin (LG 104, duplex BCC-MPM 1396); 307.- *Idem* (BP 47772); 437.- *Idem* (H); 437.- *Idem* (H); 26.- A proximité N du Barcarès (Pyr.-Or.), sous jeunes Pinus *pinea* sur sable calcaire en zone littorale, 2.12.1972, leg. R. Azéma (LG, slide BCC-MPM 1399); 30.- Loire-Atlantique, Pen-Bron, dunes à *Pinus pinaster*, 17.12.1968, leg. M. Chassain (LG, slide BCC-MPM 1387); 31.- Gironde, Grayan-et-L'Hopital, Le Gurp, pinède de pins des Landes sur sable, dunes à ± 500 m de la mer, alt. ± 10 m, 10.7.1980, leg. J.L. de Sloover (LG, duplex BCC-MPM 1388); 57.- Vosgues, Vagnei, leg. L. Quèlet (UPS, slide BCC-MPM 2033); 63.- Règion littorale, "Drap" "Montagne" "Berra" "Montdaour", Automne-Hiver 1885, leg. J.B. Barla (C. Roumeguère, Fungi Gallici exsiccati 3825) (PAV); 86.- *Idem* (DBN); 303.- *Idem* (BP); 332.- *Idem* (G); 333.- *Idem* (G); 420.- *Idem* 63 (PC); 65.- In pinetis sabulosis sylvativis, Æstate ac autumno (Mougeot Stirpes Crypt. Vogeso-Rhenanae 1275) (PAV); 81.- *Idem* (DBN); 183.- *Idem* (S); 251.- *Idem* (UPS); 322.- *Idem* (G); 323.- *Idem* (G); 325.- *Idem* (G); 326.- *Idem* (G); 350.- *Idem* (E); 393.- *Idem* (JE); 144.- Dans les lieux sablonneux, les bois des Sapins, etc, rare (Desmazières, Cryptogames de France 1013) (RO); 324.- *Idem* (G); 173.- Dans les lieux sablonneux, les bois de Sapins, etc., rare, 1846 (Desmazières, Plantes cryptogames de la France 1513) (HBG); 321.- *Idem* (G); 314.- Fontainebleau, 1845, ex Herb. de Candolle, as R. virens Fr. (G); 402.- *Ibidem*, 7.1843, leg. Durieu (PC); 403.- *Ibidem*, 6.1843, leg. M. Durieu (PC); 315.- Gujan, bois sablouneux, 8.1896, leg. Muller, ex Herb. Desmazières 1955 (G); 317.- Maine-et-Loire, Marçon, in pinetis, 10.1844, leg. Tulasne (PC); 414.- *Idem* (PC); 330.- Sur les talus sablonneux, sur le grès vosgien (Raon) et sur le grès rouge (Saint-Dié), 11.1894, leg. R. Ferry (Roumeguère, Fungi selecti exsiccati 6781) (G); 362.- Nantes, 1895, leg. Menies ex Herb. Boudier (PC); 363.- Lande, leg. Peltereau ex Herb. Boudier (PC); 400.- Route de Franchard, forêt de Fontainebleau, 8.1849, leg. Tulasne (PC); 401.- Le Mans, in pinetis, leg. M. Montagne (PC); 404.- Bordeaux, 10.1843, leg. Tulasne (PC); 408.- *Ibidem* (PC); 405.- Gironde, La Teste du Buch, 10.1843, leg. Tulasne (PC); 406.- Gironde, 10.1843, leg. Tulasne (PC); 412.- *Ibidem*, ex Herb. Boudier (PC); 407.- Près de Bordeaux, 10.1843, leg. Tulasne (PC); 409.- Redon, Ile-et-Villaine, 8.1843, leg. E. Talabardon (PC); 410.- Loire-Inférieure, Saint-Etienne-de-Monluc, sous les pins, dans l'humus, 11.1887 (PC); 411.- Collection Desmazières 1863 (PC); 421.- Paris, 10.1955 (PC). **Germany**: 55.- In monte Oelberg prope Hostrichian-Germany, in pinetis raro, Autumno, leg. Fuckel (Fungi Rhenani exsiccata 1250) (UPS, slide BCC-MPM 2032); 64.- *Idem* (PAV); 56.- Altmark, inder Näke von Arendsee, unter Kiefers, 1877, leg. R. Hesse (UPS, slide BCC-MPM 2035); 60.- Wald bei Klein-Machnow bei Berlin, 8.1881, leg. P. Sydow (Sydow, Mycotheca Marchica 386) (ABD); 71.- *Idem* (STR). 168.- *Idem* (HBG); 174.- *Idem* (HBG); 179.- *Idem* (S); 181.- *Idem* (S). 252.- *Idem* (UPS); 354.- *Idem* (W); 62.- Driesen, in pinetis, leg. Lasch (Raben. Klotzs. Herb. Viv. Myc. 420) (PAV); 305.- *Idem* 62 (BP); 67.- Dölmer Heiden, 8-9.1870 (STR); 75.- Weidhausen, Bayern, 13.6.1977, leg. Engel (Groß 225, slide BCC-MPM 2062); 76.- Dierleshausen, Niedersachsen, *Pinus* sylvestris, sandboden, 19.8.1972, leg. Kautt (Groß 528); 77.- Bexbach, Saar, Karbon-Bergehalde, 17.10.89, leg. Lang (Groß 1117); 85.- Brandenburg, Sophienstädt bei Biesenthal, Nieder-Barnim, in sandingen Kiefernwäldern, 16.9.1912, leg. P. Sydow (Sydow, Mycotheca germanica 1060) (DBN); 108.- *Idem* (BUCM); 110.- *Idem* (C); 165.- *Idem* (HBG); 254.- *Idem* (UPS); 301.- *Idem* (BP); 344.- *Idem* (E); 355.- *Idem* (W); 378.- *Idem* (CUP); 392.- *Idem* (JE); 394.- *Idem* (JE); 88.- In montibus prope Königsbrück et Pulsnitz, Saxoniae, Aestate et autumno 1879/80, leg. R. Staritz (Rabenhorst-Winter, Fungi europaei 2640) (L); 155.- Niederbayern, Vom Wild, nördl St. Joham, kr. Mainburg, Hallertan, 17.11.1958, leg. J. Poelt (M); 156.- Nürnberg, August 1926 ex Herb. Soehner 1152 (M); 159.- Dürnbucher Forst bei St. Johann unweit Siegburg, 4.10.1964, leg. Exk. B.B.G. (M); 160.- Maisteg bei München, Sommer 1921, leg. Soehner 1151 (M); 161.- Lippspring [NNE of Pderborn 51°46'Nm 8°50'E], 8.1866, in Herbarium H. Wilms 110 (M); 162.- Bayern, Siegenburg, auf Sanddüne unter *Pinus sylvestris*, 23.9.1986, leg. M. Uhl 198 (M); 164.- Falkenberg, Guschwitz as *Rhizopogon virens* (Albertini et Schweiniz) (J. Schroeter, Pilze Schlesiens 1685) (HBG). 309.- *Idem* 164 (BP); 166.- Mark Brandenburg bei Herzendorf, 23.7.1906, leg. Behse (HBG); 170.- Wald bei Zehrendorf bei Berlin, 10.1881, leg. P. Sydow (HBG); 175.- Tegel [municipal district of Berlin], Kiefernheide südlich vom Weg nach den Wasser...nahe der Villa Jacobsen, 26.8.1998, leg. Ed..? Kraetz, ex Her. P. Magnus (HBG); 184.- Neuhof bei Juikenwalde, 8.1896, leg. P. Sydow (S); 185.- Wald bei Schmörkwitz bei Berlin, 30.7.1905, leg. P. Sydow (S); 189.- Stahnsdorf, Berlin, 8.1896, leg. P. Sydow (S); 193.- Germania, leg. Pastchter (S); 331.- In pinetis prope Fr. Weinheim, non frequens, Autumno (G); 346.- Grunewald, prope Berlin [meanwhile a district of Berlin], leg. P. Hennings, Berlin Rec[eive]d Ap. 1894 [unshure whether collected in April, 1894] (E); 372.- Oberlausitz, 1941, leg. Max Seidel et al., ex Herb. Soehner 1571, as *R. angustisepta* Zeller & Dodge (M); 375.- Berlin, Grunewald, 8.1875, leg. P. Magnus (CUP); 395.- Falkenberg, kieferwald, 19.7.1948, leg. P. Eberk (JE); 396.- Treuenbrietzen, aus der Umgebung, 20.9.1974, leg. Gröger (JE); 399.- Berlin, 9.1876, leg. P. Magnus (PC); 413.- Marne, 1938 ex Herb. Boudier (PC); 424.- Branderburgia, in pinetis ad Sophienstadt prope Ruhlsdorf, m. Oct., leg. H. Sydow as *Rhizopogon provincialis* Tul. (Sydow, Kryptogamae exsiccatae 2509) (H); 66. Without locality, in pinetis mox hypogaeus mox vertice emersis ab Augusto in autumnum usque (Rabenhorst, Herb. mycologicum. Ed. II. 320) (PAV). 70.- *Idem* (STR); 69.- # Daßrig Furkel (STR); 73.- # Dillamer Haide bei Halle, 1867 (STR). **Italy**: 374.- Parma, Bedonia, 600 m, 14.9.1984, leg. A. Montecchi 993 (duplex BCC-MPM 1523); 2522.- Lucca, Arsinia, bosco misto con *Pinus pinaster*, 200 m, 16.11.1991, leg. M. Sarasini (Sarasini 434); 2525.- Pombia, MO, bosetti ticino con pini, 3.11.1990, leg. A. Bolognini (Sarasini 571), 2526.- Fondo, TM, Regole, pini silvestre con pecci e larici, 1200 m, 17.9.1994, leg. E. Bizio (Sarasini 611). **Netherlands**: 18.- Noord-Bradant, Goudbergven, Nieuw Ginneken, near Strijbeek, at edge of path beneath *Pinus sylvestris*, 10.10.1961, leg. J.T. Palmer 238) (LG, slide BCC-MPM 1389); 19.- Baarn, park, on surface of ground amongst leafmaules adjacent *Castanea sativa*, 28.8.1966, leg. J.T. Palmer 66.203 (LG, slide BCC-MPM 1390); 89.- Staatsbossen near Spier, 25.9.1960, leg. J. van Brummelen 1215 (L); 90.- Bergen op Zoom, Groot Molenbeek, unter *Pinus*, 20.10.1953, leg. C.

Bas (L); 92.- Sbrtrijbeek, Goubergven, op kale zandige stukken in *Calluna* heide, 23.8.1954, leg. G. Douwes (L); 93.- Vaassen, Hattemerweg, sand, eikenhakhoutbosje, 21.8.1960, leg. E. Kits van Waveren (L); 94.- Warnsveld, Oct. 1892, Coll. Oudemans (L); 95.- Bij Ossendrecht, heide, N. Brabant, in zand, 13.10.1951, leg. Th. Koster 1927 (L); 96.- Garderen, 19.8.1972, leg Daams 707 (L); 97.- Leersum, Leersumse Veld, zandgrond in *Pinus* aanplant, 15.10.1960, leg. R.A. Maas Geesteranus 13456 (L); 98.- Delden, 28.9.1929 (originally in bottle-RH-2108) (L); 99.- Terschelling, West-Terschelling, grepped zanl dicht bij dennen, 18.7.1955, leg. P. B. Jansen (L). 100.- Uchelen, Willemsbos, in zand, 20.9.1959, leg. J. Mennema (L); 101.- Hoge Veluwe, prov. Gelderland, in sand under *Pinus*, 29.9.1964, leg. N.E. Nannenga (L); 102.- Driebergen, June 1862, leg. Hartien ex Herb. C.A.J.A. Oudemans (L); 104.- *Ibidem*, in de naaldbossen, June 1862, leg. L. Hartien ex Herb. C.A.J.A. Oudemans (L); 103.- Zeist, 8/9.1886, ex Herb. C.A.J.A. Oudemans (L); 105.- Lheebroek, Lheebroekerzand, in zand tussen Molinia en Calluna, 21.10.1956, leg. R.A. Maas Geesteranus 12755 (L).); 106.- Narnsveld, Oct. 1892 in Coll. Oudemans (L); 107.- Hilversum, Horneboeg, 17.10.1957, leg. J. Daams (L); 133.- Amerongen, 17.10.1960, leg. G.A. de Vries (Vries 1126); 134.- Bornia, Driebergen, near *Pinus sylvestris*, semiepigeal, in diluvial sand, 30.10.1971, leg. G.A. de Vries (Vries 539); 135.- Hilversum, near *Pinus sylvestris* in diluvial sand, 30.9.1987, leg. G.A. de Vries (Vries 1114); 136.- Boswachterij "De Vuursche", Baarn, in diluvial sand, near young *Pinus sylvestris*, 29.9.1987, leg. G.A. de Vries (Vries 1118); 137.- *Idem* (Vries 1109); 138.- Buitenzorg, Baarn, in border of young *Pinus sylvestris* plantation, between *Polytrichum juniperinum* in diluvial sand, leg. G.A. de Vries (Vries 1068); 139.- Hoge Veluwe, Otterlo, near *Pinus sylvestris* in diluvial sand, 13.11.1971, leg. F. Tjallingii (Vries 556); 140.- Drunense Duinen, sub *Pinus sylvestris* in diluvial sand, 20.10.1968, leg. W. Gams (Vries 904); 367.- Prov. Hierden, Hulsborsterzand, Gelderland in sand among *Polytrichum piliferum*, 20.10.1957, leg. R.A. Maas Geesteranus (OULU). NORWAY: 54.- Vest-Agder, Kristiania, leg. A. Blytt. (UPS); 82.- Möre og Romsdal, Molde, Molde, 22.9.1974, leg. K. Krogstad (TRH); 84.- Nordland, Steigen, Leinesfjord, UTM VR91 ?, gressmark i uttorket bekkeleie, 9.1980, leg. A. Gylseth (TRH); 197*.- Storsjøen, S. Bergenhus amt, Storsö, 18.9.1886, leg. A. Blytt. (UPS); 204*.- Hedmark, Norge teml. allm., leg. A. Blytt (UPS); 266.- Hordaland, Bergen (Fana), Nordvik, 24.8.1980, leg. Ragnhild Hange (BG); 267.- Hordaland, Tysnes, Godøysund, 13.9.1975, leg. F.E. Eckblad (BG); 268.- Hordaland, Bergen, Løvstakken, 23.9.1973, leg. W. Holm (BG); 269.- Hordaland, Kvam hd. Linga, Sörneset i blandet skog., 27.9.1980. leg. Wenche Holm (BG); 270.- Hordaland, Tysnes, Gødoysund, 20.9.1980, leg. Bjorn Hode Moen (BG); 271.- Hordaland, Bergen (Fana), Nordvik, 9.9.1973, leg. Wenche Holm (BG); 272.- Rogaland, Stavanger, Sørmarka, 9.1974, leg. R. Haukeb (BG F-786); 273.- Hordaland, Os, Ulven, blandingsskog, 30.9.1978, leg. W. Holm (BG F-785); 274.- Hordaland, Sveio, ved Sveiovatnet, furuskog, 10.9.1977, leg. A. Evensen (BG F-787); 275.- Hordaland, Voss, Kyte, barskog, 11.9.1977, leg. R. Hvoslef (BG F-783); 276.- Hordaland, Kvam, Eide, 28.9.1980, leg. B. Brunstad (BG F-779); 277.- Hordaland, Bergen, Laksevåg, N-siden av Tennebekktjern, furuskog løvblandet med Calluna, 1974, leg. C. Johnsrud (BG F-776); 278.- Hordaland, Stord, Leivik, under *Quercus*, *Pinus*, 30.9.1973, leg. F.E. Eckblad (BG F-771); 279.- Hordaland, Kvam, Omastrand, I granplanting, 19.8.1987, leg. W. Holm (BG F-780); 292.- *Ibidem*, 3.9.1978, leg. W. Holm (BG F-782); 293.- *Ibidem*, I furuskog, 28.8.1977, leg. W. Holm (BG F-781); 280.- Hordaland, Lindås, Mongstad-myren, oppe i et furutre, 12.10.1977, leg. Å. Hermansen (BG F-778); 281.- Hordaland, Askøy, Herdla, 7.9.1975, leg. E. Halvorsen (BG F-774); 282.- Hordaland, Voss, Brandsitdalen, 25.8.1978, leg. O. Balle (BG); 283.- Hordaland, Askøy, Åsebø, 28.8.1973, leg. E. Høvik & R. Hvoslef (BG F-773); 284.- Hordaland, Fjell, ved Bildøy, på Synsteholmenn, I lyngmark, 8.9.1974, leg. Gerd Akse (BG); 285.- Hordaland, Kvam, Nikoy i blandingosskog, 11.9.1977, leg. W. Holm (BG); 286.- Hordaland, Bergen, Haukås, 16.8.1983, leg. Sigurd Olsen (BG); 287.- Hordaland, Granvin i Stokselsdale, millon Kjerland og Vallavik, vid stølen Stoksel (Sponamyri), soppen låg i ei trive, att med ei furu. Omkring er det myrlendt, 1984, leg. S. Kjerland 5736 Granvin (BG); 288.- Hordaland, Samnanger hd., veien Søvik-Kvernnes, ved Kvernavatnet, 6.10.1955, leg. K. Fægri & P. Wendelbo (BG); 289.- Hordaland, Fana, 1.9.1940,

leg. J. Grief (BG); 290.- Hordaland, Fana, Stend, Hernes, 6.9.1936, leg. V.L. Offerdahl (BG); 291.- Hordaland, Bergen, sandvihsflören, ca. 200 m, buskfuruplanding, 23.10.1932, leg. K. Fægri (BG); 294.- Hordaland, Voss, Brandsetdalen, 11.8.1978, leg. O. Halle (BG F-784); 295.- Hordaland, Bergen, Munkebotten, ved Garpetjern i furuskog, 30.9.1987, leg. W. Holm (BG); 296.- Hordaland, Os, Strøno, 20.9.1973, leg. I. Dundas (BG F-777); 297.- Hordaland, Samnanger, nær Poyla, furublandingsskog, 30.9.1973, leg. M. Stavdel (BG); 422.- Nordaland, U. Porvo o mlk, Bodö, pohjoisranta, kivikkoa, lepikkoa, 26.8.1986, leg. Viljo Pekkanen (H). POLAND: 24.- # Pociecha, forêt de Kampinos, dunes à *Corynephorus* avec *Calluna* et *Juniperus communis*, 30.8.1966, leg. V. Demoulin 3434 (LG, slide BCC-MPM 1397); 25.- *Ibidem*, a demi-enterré dans le sable sous *Pinus sylvestris*, leg. I. Dudka ex Herb. Demoulin 3432 (LG, slide BCC-MPM 1398); 58.- Autgleu, k/Prószków, 8.9.1978, leg. W. Yumenynska (UPS, slide BCC-MPM 2034); 306.- Kielce, 1918, leg. Moesz (BP 36711); 304.- Zaklików, 10.9.1918, leg. G. Moesz (BP 36990). **PORTUGAL**: 11.- Agonia, 21 km au N de Viana do Castelo, dunes littorales, sous *Pinus pinaster* et *Acacia*, 28.10.1968, leg. V. Demoulin 3745 (LG, slides BCC-MPM 1381A and 1381B). **SLOVACA REPUBLIC**: 335.- Záhorie, Sajolíkové Humenné, polesie Bor, locis arenosis, 7.9.1955, leg. A. Novacky (PRM 619025); 336.- Semice, in pineto (ca 15 anun), solo arenoso, 22.9.1966, leg. Brambira (PRM 622097). **SPAIN**: 6.- Girona, Coll de l'Atalaia, carretera de LLagostera a Tossa, 20.10.1988, leg. J. Llistosella, D. Sierra & MPM (BCC-MPM 1053); 32.- Barcelona, camino forestal al Turó de l'Home, Montseny, entre encinas, 10.1990, leg. M. Tabarés (BCC-MPM 1353); 33.- Barcelona, Capellades, Muntanya de Miramar (Anoia), UTM CF99, alt. 317 m, encinar, 17.11.84 (BCC-MPM 105); 34.- Barcelona, platja del Prat de Llobregat (Baix Llobregat), dunes fixades amb *Crucianelletum maritimae*, terreny silici, 10.3.1981, leg. X. Llimona (BCC-MPM 335); 35.- Barcelona, Santa Coloma de Cervelló (Baix Llobregat), bajo Pi*nus halepensis* y *Quercus* ilex, leg. A. Canals, 10.11.1985 (BCC-MPM 521); 37.- Burgos, Espinosa de los Monteros, bajo *Pinus sylvestris*, 28.10.1991, leg. J.L. Dunabeitia & M. Aurrekoetxea (BCC-MPM 1530); 153.- *Idem* (Dunabeitia BU 4, duplex BCC-MPM 1530); 38.- Burgos, Barrio, bajo *Pinus sylvestris*, 21.10.1989, leg. M.K. Dunabeitia (BCC-MPM 533); 154.- *Idem* (Dunabeitía BA13); 380.- *Ibidem*, 12.11.1989, leg. M. Dunabeitia A-282 (MA-Fungi 28326); 39.- Girona, Riells (La Selva), bajo *Quercus suber* y *Pinus halepensis*, 8.6.1992, leg. A. Rocabruna (BCC-MPM 1545); 40.- Girona, Vidreres, urbanización La Goba (La Selva), pinar, 30.10.1992, leg. F. Bueno & MPM (BCC-MPM 1573); 41.- *Idem* (BCC-MPM 1574); 42.- Girona, Gatosa d'en Riusec, Llagostera (La Selva), bajo *Quercus suber*, 2.12. 1992, leg. A. Sánchez (BCC-MPM 1591); 2436.- *Ibidem*, bajo *Quercus suber*, cerca de *Pinus halepensis*, *Erica* sp. and *Arbutus unedo*, 7.11.1993, leg. D. Sierra (BCC-MPM 1727); 298.- La Coruña, Brión, Adoufe, 29TNH2645, 27.10.1980, leg. L. Cabo Rey (MA-Fungi 4173); 299.- Pontevedra, Gondomar y Tomiño, 25.10.1982, leg. F.D. Calonge (MA-Fungi 4549); 361.- Cádiz, Cortes de la Frontera, pinar, 15.11.1987, leg. A. Ortega, M. Zea, M.T. Vizosa (Micoteca Hispanica 25521) (GDAC); 373.- Cádiz, 10.1992, bajo *Pinus pinea*, leg. B. Moreno (BCC-MPM 1674); 381.- Cantabria, Castanedo, 100 m, *Pinus radiata*, 1.10.1986, leg. M. Dueñas & C. Colinas A-122 (MA-Fungi 28327); 382.- Pontevedra, Bueu, *Pinus pinaster*, parcela quemada, 21.11.1985, leg. I. Alvarez & C. Colinas A-2 (MA-Fungi 28328); 383.- *Ibidem*, leg. I. Alvarez & C. Colinas A-1 (MA-Fungi 28329); 384.- Pontevedra, *Pinus pinaster*, suelo compacto cerca de parcela quemada, 20.11.1985, leg. I. Alvarez A-3 (MA-Fungi 28330); 385.- Pontevedra, Aios, *Pinus pinaster*, suelo arenoso, 23.11.1985, leg. A. Rigueiro A-7 (MA-Fungi 28331); 390.- *Ibidem*, leg. A. Rigueiro A-6 (MA-Fungi 28336); 386.- Pontevedra, Cerponzóns, 29TNH2903, *Pinus pinaster*, suelo arenoso, 23.11.1985, leg. A. Rigueiro A-7 (MA-Fungi 28332); 389.- *Ibidem*, *Pinus pinaster*, parcelas quema controlada, 6.11.1987, leg. R. Molina A-215 (MA-Fungi 28335); 387.- Pontevedra, Boiro, *Pinus pinaster*, zona quemada, 4.11.1987, leg. I. Alvarez A-209 (MA-Fungi 28333); 388.- Pontevedra, Cuntis, *Pinus pinaster*, plantación joven, 6.11.1987, leg. I. Alvarez & Parladé A-214 (MA-Fungi 28334); 2376.- Pontevedra, Marín, pinar, 22.5.1983, leg. J. Moldes & F. Rodriguez (Castro 588); 2437.- Girona, Dunas de Begur (Baix Empordà), 16.11.1993, leg. Corsino (BCC-MPM 1735); 2445.- Girona, Santa Coloma de Farnés (La Selva), Km 5.8 hacia

Sant Hilari, Can Huix, bosque de *Quercus ilex*, *Pinus pinaster*, 9.10.1994, leg. X. Font (BCC-MPM 1873); 2523.- Barcelona, Sant Celoni (Vallès Oriental), radura con pini maritimi, 26.10.1993, leg. A. Rocabruna (Sarasini 514); 2524.- Girona, Sant Grau (La Selva), *Pinus radiata*, *P. pinaster* and lecci, 27.10.1993, leg. A. Sarasini & F. Bersan (Sarasini 520). **SWEDEN**: 36.- Uppland, Uppsala, city forest, 9.9.1991, leg. MPM (BCC-MPM 1465); 43.- Dalarna, Orsa, 20.8.1909, leg. E. Lind (UPS); 44.- Hälsingland, Harmånger sn, Strömsbruk, vid Andratjärn, på gångstig, 26.6.1948, leg. Berit & J. Eriksson (UPS); 45.- Lule Lappmark, Gällivare sn, Muddus national park, ung 1 Km S on Stubba-Stugan, på sandigstig, 21.8.1949, leg. Berit & J. Eriksson 3756 (UPS); 46.- Västergötland, Hunneberg, 24.8.1897, leg. L.J. Hallgren (UPS); 47.- Småland, Femsjö, 9.10.1911, leg. L. Romell, NEOTYPE, here designed (UPS); 191.- *Idem* (S); 48.- Gotland, Linde sn, öster om kyrkan, Sept. 1896, leg. Karl A. Grönvall (UPS); 49.- Gotland, Eke, broander (Torkat fragm. av. spritlagt mat.) (UPS); 50.- Västergötland, Skallsjö sn, Floda i barrskog, 16.8.1889, leg. L. Romell (Myk. Ant. 821) (UPS); 51.- Uppland, Östhammar, 28.8.1895, leg. Elias Nordtröm (torkat fragment av. sprittagt mat) (UPS); 52.- Uppland, Häverö sn, Häverö, på en gräsbevuxen skogsbacke, 5.8.1894, leg. L. Romell (UPS); 186.- *Idem* (S); 145.- Västergötland, Horred sn, Rödvik, 30.8.1964, leg. A. Thungren (GB); 146.- Västergötland, N. Vings sn, Axvall, Krabbeskogen, I barrskog, 8.10.1958, leg. F. Karlvall 8711 (GB); 147.- Bohuslän, Jörlanda sn, Toröd, I barrskog, 20.9.1956, leg. F. Karlvall 7060 (GB); 148.- Västergötland, Göteborgs Botaniska Trädgård, Arboretet, I barrskog, 15.9.1958, leg. F. Karlvall 8328 A (GB); 149.- *Ibidem*, 19.9.1963, leg. F. Karlvall 10670 (GB). 152.- *Ibidem*, 3.10.1967, leg. F. Karlvall 12716 (GB); 150.- Bohuslän, Lane-Ryrs sn, nära Kyrkesjötrakten, I barrskog, 17.9.1966, leg. F. Karvall 11996 (GB); 151.- Småland, Femsjö sn, Hågnen, I blandskog, 25.9.1967, leg. J. Boberg (GB); 187.- Uppland, Uppsala, 11.9.1893, leg. H. von Post (S); 188.- Gotland, Ö. om Linde Kyrka, 9.1896, leg. K.A. Grönvall (S); 190.- Västergötland, Göteborg, Floda, 16.8.1889 (S); 195*.- Skåne, vegeholms plantering, 6.8.1888, leg. W. Bülow (UPS); 196*.- Västergötland, Timmerå, Lerum, 8.1902, leg. A. Södersen (UPS); 198*.- Södermanland, Dalarö, Kymendö, Juli 1881, leg. Strindberg (UPS); 199*.- Bohusland, Osnot, Rossö, 18/25.8.1892, leg. H.W. Arswells (UPS); 200*.- Skåne, St. Åhus, Sept 1883, leg. L.G. Wahlstest (UPS); 201*.- Södermanland, Dalarö skärgård, 1881, leg. A. Sturberg (UPS); 202*.- *Ibidem*, 24.8.1892, leg. H.W. Arnoll (UPS); 205.- Uppland, Gysinge, close to the plantschool, lying on sand, which was poorly overgrown with *Pinus sylvestris* and *Arctostaphylos uva-ursi*, 23.9.1981, leg. B. Owe-Larsson (UPS); 206.- Öland, Böda, Skeppstäusbadet, 23.9.1956, leg. R. Schöldström (UPS); 207.- Norrbotten, Pajala. 9.1896, leg. H. Johansson (UPS); 208.- Hälsingland, Harmånger sn, Stromsbruk, vägen till Alderviken, på grusig väg, 4.7.1948, leg. Berit & J. Eriksson 3042 (UPS); 209.- Gotland, 9.1893, leg. T. Vestergren (UPS); 211.- Jämtland, Fors sn, Bispgården, leg. H. Benckert UPS); 212.- Uppland, Älvkarleby sn, Bremsand, på sand, 24.9.1950, leg. G. Fåhraeus & G. Stenlid (UPS); 213.- Jämtland, Brunflo park, in soil in coniferous forest on calcareous ground, 18.8.1984, leg. I.B. Vesterberg (UPS); 214.- Häsingland, Norrbo sn, Tjärnavallen, 20.8.1895, leg. L. Romell (UPS); 215.- Norrbotten, Tärendö sn, 3 Km N om Saittajärvi och 1 Km W om vägen, på norra stranden av. Syväjoki, 2.10.1963, leg. O. Lönnquist (UPS); 216.- Häsingland, Los, 1908, leg. E.A. Fries (UPS); 217.- Jämtland, Mörsils, vid stigen mellan landsvägen och kvarntjärns utlopp i Gisterån, 13.9.1961, leg. N. Hakelier (UPS); 218.- Norrbotten, Övertorneå sn, Hirvijärvi, ca. 25 Km WNW Matarengi, 200 m S om landsvägen, vägen till grustaget, 7.9.1948, leg. O. Lönnquist (UPS); 219.- Uppland, Uppsala (Bondkyrka), Ultuna, 9.1889, leg. H. von Post (fragm. av. spritlagt mat.) (UPS); 220.- Lule Lappmark, Gällivare sn, Muddus nationalpark, på stigen mellan Lucbbalkietsi och Mansar, på sandind stig, 28.8.1948 (UPS); 221.- Uppland, Älvkarleby sn, ca 1.5 km NNW om Harma station, på sanding mark i tallskogsbryn, avrödjning ca. 15 m från landsvägen, 1.10.1954, leg. S. Lundell (UPS); 222.- Småland, Femsjö sn, stigen mot Stubbebo, nära bäcken, ej långt från Elmhultsvägen, under tall på sanding gångstig i barrskog, 15.9.1940, leg. S. Lundell & G. Haglund 5431 (UPS); 223.- Gotland, Källunge sn, åkerkant nära kyrkan, 26.8.1947, leg. E. Th. Fries (UPS); 224.- Norrbotten, Övertorneå sn, Hankinvittikko fäbod, ca 10 Km NW

Övertorneå, på gammal, av gräss och mossa övervuxen väg, 29.8.1956, leg. O. Lönnquist 229 (UPS); 225.- Skåne, Åhus sn, Äspet, 26.8.1889, leg. L.J. Wahlstedt (UPS); 226.- Gotland, Fårö, Ava, sandig väg, 18.8.1947, leg. E.Th. Fries (UPS); 227.- Dalarna, St. Tuna, SV om Lennheden, Vägkantdike, 24.8.1980, leg. R. Morander 3834 (UPS); 228.- Uppland, Danmark parish, ca. 0.5 km SE of the railway station of Bergsbrunna, on sandy roadside in an open *Pinus sylvestris* forest, 29.7.1956, leg. R. Santesson 11485 (UPS); 229.- Södermanland, Ornö sn, Kymmendö, 7.1881, leg. A. Strindberg (fragm. av. spritlagt mat.) (UPS); 230.- Gotland, Vamlingbo sn, Bustre, ung tallskog på flygssand nära stranden, 28.9.1947, leg. B. Pettersson (UPS); 231.- Västergötland, sandstranden vid Halleberg, leg. C.O. Noren (torkat fragment av. spritlagt am) (UPS); 232.- Gotland, Vesterhejde, 6.9.1903, leg. Thilda Stalhandske (fragm. av. sprittagt mat) (UPS); 233.- Bohuslän, Tjärnö sn, Rossö, 25.8.1892, leg. H.W. Arnell (fragm. av. spritlagt mat.) (UPS); 234.- Uppland, Dannemora, 1873, leg. L. Lagergen (UPS); 235.- Uppland, Bondkyrka sn, 9.1882, leg. H. Juhlin-Dannfeldt (UPS); 236.- Ångermanland, Vibyggeria por, Mjältön island, in the bay called Norraspirken, on sandy ground, 17.8.1972, leg. R. Moberg 1903 (UPS); 238.- Gotland, Fårö, Eke, 9.1895, leg. N. Broander (UPS); 239.- Skåne, Åhus, 9.1883, leg. L.J. Wahlstedt (torkad skiva av. spritlagt material) (UPS); 240.- Gotland, Visby, Hösten 1893, leg. T. Vestergren (UPS); 241.- Uppland, Danmark sn, Linnés Hammarby, 1908, leg. C.G. Lloyd (UPS); 243.- Bohuslän, Restenäs, Ulvesund, *Pinus*, 2.11.1974, leg. L. Bredford, A. Bohlin & M. Jeppson (Jeppson 642); 244.- Västerbotten, Umeå, Kåddished, in sandy pine forest, 5.9.1975, leg. M. Jeppson (Jeppson 734); 245.- Bohuslän, Naverstand, Frötemarken, along pine roots, 29.8.1972, leg. M. Jeppson (Jeppson 11); 246.- Öland, Böda, Homrevet, Pinus forest on sandy dues, 9.9.1988, leg. M. Jeppson (Jeppson 2625); 247.- Bohuslän, Herrestad, Mollön, coniferous forest (*Picea*, *Pinus*), along path, 16.8.1988, leg. M. Jeppson (Jeppson 2471); 248.- Västergötland, Fors, S of Lake Trehörningen, sandy pine forest, 8.9.1974, leg. M. Jeppson (Jeppson 532); 249.- Västmanland, Nora, Linde, barrskog in coniferous forest, 16.9.1973, leg. M. Jeppson (Jeppson 414); 253.- Gotland, Mästermyi, 9.8.1905, leg. J.E. Ljungquist (UPS); 426.- Värmland, Ekenäs l.k. Ivärminne, 20.7.1937, leg. N. Malmström (H). **SWITZERLAND**: 91.- Spiez, Kibbelhock, Spaarzaam met *Polytrichum* begrocide zandolahte, 25.9.1960, leg. R. A. Maas Geesteranus 13452 (L); 178.- Silter, 27.8.1864, leg. P.A. ex Herb. P. Magnus (HBG). **UNITED KINGDOM**: 12.- Scotland, Culbin forest, 9.9.1963, leg. P.K.C. Austwich & D.M. Dring (Flora of the British Isles EB 52) (LG, slide BCC-MPM 1383); 78.- England, Ceaserb Camp., near Bracknell Berkshire, trees *Pinus sylvestris* and *P. contorta*, 9.9.1943, leg. E. Gren (Flora of Bershire) ex Herb. Watling 10096 (E); 79.- Scotland, Black Wood of Rannoch, 26.8.1954 (E); 80.- Scotland, Glass, under *Pinus*, 27.9.1985, leg. B. Ing. ex Herb. Watling 18415 (E); 109.- England, New Forest, Hants N° Bulieu, 3.10.1987, leg. D.A. & S.F. Reid (C); 308.- England, Cap. bon. Spei, inter acus pinorum in silva "Rondebosch" prope Somerset-East, 5.1882, leg. P. Mas Owan as *Melanogaster Owanianus* Kalchbr. (Rabenhorst-Winter, Fungi europaei 3436) (BP); 312.- *Idem* (G); 313.- *Idem* (G); 360.- *Idem* (W); 425.- *Idem* (H); 310.- England, Lyndhurst, Hants, under *Pinus sylvestris*, leg. R.W.G. Dennis, ex Her. Palmer 148 (K); 339.- England, Bicton Common, Devon, 12.7.1954, leg. T. Wallace ex Herb. Hawker 1051 (K); 359.- England, Ringwood Hants, 5.10.1925, leg. K.J.H. Corner (W); 379.- England, Exeter, Haldon forest, 22.10.1954, leg. T. Wallace ex Herb. Hawker 1106 (K).

Extralimital collections. AUSTRALIA: 340.- Creswick, under *Pinus radiata*, plantation, 28.4.1982, leg. R. Watling 14777 (Flora of Victoria) (E); 341.- *Ibidem*, 27.4.1982, leg. R. Watling 14705 (Flora of Victoria) (E); 342.- *Ibidem*, 27.4.1982, leg. R. Watling 14773 (Flora of Victoria) (E); 347.- Melbourne, Studley Park, 11.6.1889, leg. A. Morrison (E); 348.- *Idem* (E); 349.- *Idem* (E). CHILE: 338.- Concepción, 10.1905, leg. R. Thaxter ex Farlow Herbarium 6383 (PRM 681420). NEW ZEALAND: 1.- Bank's Peninsula, 1874, leg. S. Berggren 403, as *Rhizopogon induratus* Cke. (LD, slide BCC-MPM 2144); 2.- *Idem* (UPS, slide BCC-MPM 2011); 5.- Maungarca, ins. boreal, 7.1874, leg. S. Berggren (UPS). SOUTH AFRICA: 28.- Prov. du Natal, Drakensberg Garden, alt. env. 1700 m, dans l'humus d'une touffe de fougère, pelouse ombragée d'arbres plantés (*Pinus*, *Acacia mearnsii*,...) sur versant gréseux au-dessus de l'hôtel, 6.2.1982, leg. J. Lambinon 82/313 et Reekmans ex Herb. Lambinon 82/326 (LG, slide BCC-MPM 1400). UNITED STATES: 316.- California: San Francisco, Ingleside district, south of Golden Gate Park, under leaves, beneath eucalyptus and pine trees, 29.10.1904, leg. N.L. Gardner 208 as *Rhizopogon provincialis* (California Fungi 558) (G); 358.- *Idem* (W); 423.- *Idem* (H); 318.- California: Humboldt County, Trinidad, Spruce Cove, in gravelly driveway, 10.1938, leg. S.T. & H.E. Parks 6168 (G, slide BCC-MPM 2175). URUGUAY: 210.- Carrasco, Dep. de Canelones, in pinetis, alt. 5 m as *Rh. roseolus* (Cda.) Hollós (Plantae Uruguayenses Exsiccatae, ex Herb. Hert. 50103) (UPS); 311. Carrasco, in pinetis, 1948, leg. Herter as *Rhizopogon* roseolus (Cda.) Hollós (Plantae Uruguayenses Exsiccatae, ex Herb. Hert. 50172) (G). ZAMBIA: 27.- Chati, under *Pinus kesiya*, 3.3.1979, leg. G.D. Piarce FP 6/8/1 dupl. (LG, slide BCC-MPM 1401); 29.- Choma, under *Pinus kesiya*, 25.3.1980, leg. G.D. Piarce FP 650/1 (LG, slide BCC-MPM 1402).

Unkown locality. 4.- Without locality and date, leg. Vittadini, misist Berkeley as *Rhizopogon graveolens* (Vitt.) Tul ex Herb. Tulasne 300 (PC); 72.- # Prope Baeckhorst, ad vias arenosas et in pinetis aestate-autumno, 1861, leg. Th. Sprée, as Splanchnomyces Rabenhorstii Corda (Rabenhorst, Fungi europaei 570) (STR); 141.- *Idem* (RO); 143.- *Idem* (RO); 158.- Idem (M); 169.- *Idem* (HBG); 171.- *Idem* (HBG); 180.- *Idem* (S); 250.- *Idem* (UPS); 300.- *Idem* (BP); 319.- *Idem* (G); 320.- *Idem* (G); 327.- *Idem* (G); 83.- ? Beim Fayke Nature Reserva, associated with kirsch, 29.9.1955, (E); 87.- ? Prope Sormewalde in Lufatia monti, in pinetis, 8.1845, leg. C.T. Krotoshmas (DBN); 343.- *Idem* (E); 351.- *Idem,* ex Herb. Cooke 1885 (E); 142.- Without locality and date, in pinetis mox hypogeous mox vertice emergus ab Augusto in Autumnum usque, leg. G. Doria (RO); 157.- Without data, as *Tuber obtextum* Spr. (M); 163.- Illegible locality, 8.1948, ex Herb. K. Walther acc. 10.3.1975 (HBG); 167.- Illegible locality, 3.8.1918, leg. Brick (HBG); 172.- Illegible locality. ex Herb.P. Magnus acc. 1918 (HBG); 176.- Illegible locality, 1876 ex Herb. P. Magnus (HBG); 177.- Without data, ex Herb. P. Magnus (HBG); 182.- Without locality, pineti, 1900 (S); 192.- Without locality, in silvis, leg. Eichler ex Herb. Bresadola(S); 194.- # Veinves, 1.1905, leg. Bataille (S); 345.- Without locality, 1826, Fries (E); 415.- ? In pinetis Fontis bellaquae, 7.10.1845 (PC); 416.- *Ibidem*, 11.6.1843. leg. Durieu (PC); 418.- *Ibidem*, 7.9.1890 (PC); 417.- ? Wollage Courtroi (PC); 419.- Without locality, bois de sapins (PC); 435.- Without locality, bois de sapins ex Herb. Desmazière (H).

Rhizopogon marchii (Bres.) Zeller & Dodge

European collections. **AUSTRIA**: 827.- Petersdorf, 26.10.1909 (W 1597); 830.- Tirol, 3.8.1902, leg. O. Magnus (JE). **CZECH REPUBLIC**: 812.- Cernošice, 12.1926, leg. J. Velenovský as *R. graveolens* (PRM 149254); 813.- Mnichovice, in picetis, 24.9.1934, leg. J. Velenovský as *R. comatus* Vel. (PRM 154789); 816.- *Ibidem*, 8.5.1936, leg. J. Velenovský (PRM 154790); 814.- Mnichovice, Mirosvrice, in nemore, 20.6.1936, leg. J. Velenovský as *R. comatus* Vel. (PRM 154788) (Flora bohemica); 815.- *Ibidem*, in pineto, 6.1936, leg. Velenovský as *R. comatus* Vel (PRM 154799); 817.- Mnichovice, Myšlín, in calluneto (extra silvam), 8.1931, leg. J. Velenovský, LECTOTYPE of *R. comatus* Vel. (PRM 154795); 808.- # Vonoklasy, in piceto, 9.7.1950, leg. V. Vacek as *R. graveolens* Tul. sensu Vel (non Tul.) f. *pomaceus* Vacek (PRM 619033); 809.- # Třebotov, in silva mixta (*Pinus sylvestris*, *Quercus*), sub terram, 27.10.1946, leg. V. Vacek, SINTYPE of *R. graveolens* Tul. f. *sulphurea* Vacek (PRM 619037); 810.- # Všeradice, in silva acerosa, 10.7.1950, leg. A. Dvořak, as *R. graveolens* Tul. sensu Vel. non Tul. (PRM 619036); 811.- # Zărošice, in silva mixta (*Quercus*, *Pinus sylvestris*), sub terram, 26.7.1948, leg. V. & V. Vacek as R. graveolens Tul (PRM 619031). **FINLAND**: 807.- Ostrobottnia borealis, Rovaniemi rural commune, Pekkala, ca. 1 km E of the crossroad to Kaarnijärvi, near the house of Armas Nurmela, dry heath forest, Grid 27° 7362:492, 9.9.1971, leg. L. Kaihua (TUR 67827). **FRANCE**: 799.- Mâcon, *Picea*, 4.8.1987, leg. M. Meyer (Mornard 8713G, duplex BCC-MPM 1717); 829.- Avignon, 10.1974, leg. V. Demoulin (Vries 1056). **GERMANY**: 823.- Schwenningen a N, 20.6.1950, leg. Haas ex Herb. Soehner 2264 (M); 824.- *Ibidem*, 30.7.1953, einer Kieferg.tünden, leg. Haas ex Herb. Soehner 2368 (M); 825.- *Ibidem*, 11.8.1953, leg. Haas & Mark ex Herb. Soehner 2370 (M). **ITALY**: 801.- Tirolo meridionale, nelle selve montane presso Bolzano, 1865, leg. Hausmann as R. rubescens (Erb. Crittogam. Ital.-Ser II 42) (FI); 803.- Italien, Fitchen auf saurem Boden, 7.1988, leg. Montecchi (Groß 1089); 804.- Verla, in prato alpine, 9.1897, leg. Bresadola (S); 805.- *Ibidem*, in pineti (S); 822.- *Ibidem*, in pineti, 9.1897, leg. Bresadola, ex Herb. Bresadola 897, ISOTYPE (M); 828.- Trento, Paneveggio, Picea, 1600 m, 18.8.1988, leg. A. Montecchi 897 (duplex BCC-MPM 1527); 800.- 6.1.1920 von Bresadola erhalten, ex Herb. Soehner 1150 (M). **SPAIN**: 796.- Barcelona, Sant Pere de Ribes, Peñón del Obispo (Garraf), en un camino en un bosque de *Pinus halepensis*, UTM CF97, 44 m, 19.10.1986, leg. F. Bueno & MPM (BCC-MPM 691); 797.- Girona, Masia de Voltregà (Osona), pineda de pi roig i boix, 24.9.1990, leg. E. Gràcia (BCC-MPM 1322); 798.- Teruel, Mosqueruela, bajo pino rojo, pinar viejo, 10.6.1989, leg. A. Rocabruna (BCC-MPM 1096); 819.- Alicante, Guardamar, playa de la Pinada, dunas junto a *Pinus halepensis*, YH 0613, 1 m, 26.1.1980, leg. M. Honrubia 2811, as *R. rubescens* Tul. (MUB 1779); 820.- Alicante, Guardamar, junto casa de Icona, dunas junto a *Pinus halepensis*, YH0613, 1 m, 24.3.1979, leg. M. Honrubia 1754, as *R. rubescens* Tul. (MUB 1769); 826.- Alicante, Torrevieja, Urbanización Los Balcones, pinar de *Pinus halepensis*, XG 9804, 2 m, 3.11.1979, leg. D. Gomez ex Herb. Honrubia 2577, as *R. rubescens* Tul. (MUB 1778). **SWEDEN**: 802.- Gotland, Fårö, Ava, sandig gångstig, 23.8.1948, leg. E.Th. Fries (UPS); 806.- Gotland, 30.7.1902 (S).

Rhizopogon melanogastroides M. Lange

European collections. **CZECH REPUBLIC**: 831.- # Moravia, M. Weisskirchen sub *Pinus*, 10.1928, leg. F. Petrak, TYPE (C).

Rhizopogon occidentalis Zeller & Dodge

European collections. **AUSTRIA**: 860.- Tirol, Seefeld, Föhren-richtenwald, 16.10.1949, leg. M. Moser, as R. luteolus (M). **CZECH REPUBLIC**: 661.- Nymburk, 15.6.1966, leg. K. Pilát, 15.6.1966, leg. K. Pilát, as *R. luteolus* (PRM 622824). **DENMARK**: 852.- Nordjylland: Hurup Sande, 12.10.1982, leg. J. Vesterholt, as *R. luteolus* (C). **FINLAND**: 913.- Ostrobottnia borealis, Vehmaansuo, under rotten log on banck of ditch trough eutrophic bag, Grid 722:44, 14.8.1972, leg. Tauno Ulvinen (OULU); 914.- Nylandia, Björkstär, 13.8.1937, leg. E. Häyrén, as *R.luteolus* (H); 915.- Ostrobottnia kajanensis, Kontinjoki, E side of the part of the lake Löytölampi, to W in terraces sloping, rich grass-herb spruce forest with hardwood bushes, *Cypripedium* abundant, spreingy swamp with *Alnus* inc. *Salix*, Grid 27° E 7115:543, UTM NM2, 9.9.1985, leg. I. Kytövuori 85989 (H); 916.- Karelia borealis, Koli, Tarhapuro, kangasmetsä, 4.9.1983, leg. M. Korhonen 5526 (H); 917.- Regio kuusamoënsis, Oulanka, läh. Biologista asemaa, 23.8.1978, leg. T. Ulvinen (H); 918.- Ostrobottnia kajanensis, Korvanniemi, Aarreniemi, lehtotiellä, Grid 27°E 7122:546, leg. 14.8.1976, leg. R. Tuomikoski & M. Korhonen 1540 (H). **FRANCE**: 853.- Egalyere de Fray, Alpilles, Var, Frankreich, *Quercus ilex*, *Pinus halepensis*, 1.11.1982, leg. Riousset, as *R. briardii* Boud. (IB); 904.- Corse, dunes côtieres de la baie de Calvi, un peu à l'E de la ville, UTM MN81, 42.2N/8.4.E, sous *Pinus pinaster* et *P. pinea*, 5.10.1972, leg. V. Demoulin, as *R. vulgaris* (BP 58092); 905.- Near Avignon, 10.1974, leg. L. Riousset (Vries 658), as *R. briardii* (Vries 658, slide BCC-MPM 2187). [In the same envelope, a fruitbody of *Tuber borchii* Vit.]. **GERMANY**: 662.- Insula Rüge, prope Glowe, ad terram arenosam sub *Pinus silvestrium*, 24.8.1958, leg. H. Vintiková, as *R. luteolus* (PRM 619026); 847.- Dreisen, in pinetis, leg. Lasch, ex Herb. Saccardo 420, as *R. luteolus* Fr. (PAD); 856.- Siegenbürg, Hallertaii, 19.6.1965, leg. Einhellinger, as *R. luteolus* (M); 857.- In monte Oelberg, in pinetis, raro as *R. luteolus* Fr. (Fuckel, Fungi rhenani 1250) (M); 858.- Umgeburg von Augsburg, Stätzling, 9.1960, leg. A. Bresinsky, as *R. luteolus* (M); 861.- Wald bei Marienweiher, 8.1941, leg. D. Neuhoff ex Herb. Soehner 1583, as *R. luteolus* (M); 863.- Moorwaldungen, 12.10.1963, leg. Philipp (M); 864.- Pupplinger, Heide bei Wolfratshausen, fast epigaeisch, im Gras, beschattet von Föhren, leg. Soehner 1543, as *R. luteolus* (M); 895.- Altmark, unter Kiefern, 1877, leg. R. Hesse, as *R. luteolus* Fr. (UPS). **GREECE**: 867.- Biga, leg. F. Bucholtz 1901, as *R. luteolus* (S). **ITALY**: 832.- Tirolia, Jenesien prope Bozen, in silvis, m. Sept., leg. F. de Höhnel, as *Rhizopogon luteolus*

(Kryptogamae exsiccatae 1607)(FI); 833.- *Idem* (M); 834.- *Idem* (C); 835.- *Idem* (G); 836.- *Idem* (G); 837.- *Idem* (S); 838.- *Idem* (HBG); 839.- *Idem* (HBG); 840.- *Idem* (WU); 841.- *Idem* (PRC); 842.- *Idem* (LD); 848.- *Idem* (BUCM 66321); 859.- Trento, 10.1924, leg. Bresadola ex Herb. Killerm, as *R. luteolus* (M); 862.- *Idem* 859, ex Herb. Bresadola 1805 as *R. luteolus* (M); 865.- Tirol, S. Vigil in Enneberger, Kiefernwald, 19.8.1910, leg. P. Magnus, as *R. luteolus* (HBG); 866.- Verla, in pinetis, 9.1897, leg. Bresadola, as *R. luteolus* (S); 2517.- Taggia (IM), boschi colline, pini marittimi e cisti, 300 m, 10.1993, leg. M. Rizzotto, as *R. vulgaris* (Vitt.) M. Lange var. *vulgaris* (Sarasini 573); 2518.- Braga Marittima (IM), colline retroterra, pino silvestre, 300 m, 5.1993, leg. M. Rizzotto as *R. vulgaris* (Vitt.) M. Lange var. *vulgaris* (Sarasini 575). **NETHERLANDS**: 850.- Hierden, Hulshorster zand, 20.10.1957, leg. R.A. M. Geesteranus 12401, as *R. luteolus* (L 956312 652). **NORWAY**: 520.- Sör-Tröndelag, Trondheim, Elsterparken, Innlevert, 12.9.1938 (TRH); 849.- Akershus, Enebakk, ær Se-opp, i barskog, 17.8.1964, leg. O. Gjærevoll, as *R.* cf. *rubescens* Tul. (TRH); 903.- Oppland, N-land, Austsinni, under *Pinus sylvestris* on calcareous soil, 12.9.1984, leg. M. Jeppson (Jeppson 1645); 912.- Oppland, Nordre Land, Austsinni, Røberg S., mixed forest rich in herbs, on slope (influenced by calcareous waters), 12.9.1984, UTM NN 59 45-46, leg. T. Ulvinen (OULU). **PORTUGAL**: 846.- Estremadura, Sesimbra, Lagoa de Albufeira, em pinhal, 1.1991, leg. M.G. Almeida & F.D. Calonge PL2481, as R. luteolus Fr. (LISU); 901.- Soalheira, S. Fiel e arredores (nos pinhares), UTM 29TPE23, 9.1902, leg. J. da Silva Tavares, as *Rhizopogon rubescens* (Flora lusitanica exsiccata 1716) (S). **SPAIN**: 855.- Vizcaya, Harusi, *Pinus radiata*, leg. J.L. Dunabeitía & M.C. Aurrekoetxea MA 9 (duplex BCC-MPM 1534); 2377.- La Coruña, Malpica, Aron, camino bajo pinos, 21.10.1981, leg. L. Freire & M. Castro (LOU-Fungi 593); 2378.- Pontevedra, Portonovo, Paxariñas, pinar con dunas, 23.11.1991, leg. J. Moldes (LOU-Fungi 3620); 2454.- Barcelona, Terrassa (Vallès Occidental), pineda, 19.11.1974, leg. J.A. Ramírez (BCC-MPM 1916); 2464.- Girona, C. Torrent, 14.11.1985, leg. J.M. Vidal, as *R. vulgaris* (BCC-MPM 1847); 2501.- Valencia, Rafols de Salem, bajo *Pinus halepensis*, 13.12.1993 (BCC-MPM 1983); 2505.- Girona, Dunas de Pals (Baix Empordà), fixades amb *Pinus pinea*, 19.11.1993, leg. Membres Soc. Cat. Mic. (BCC-MPM 1749); 2511.- Girona, Mas Florit (Baix Empordà), bosque de *Quercus ilex*, 20.11.1993, leg. Membres Soc. Cat. Mic. (BCC-MPM 1767); 2529.- Formentera, Cap de Berberia, *Pinus halepensis*, *Juniperus phoenicea*, *Pistacia lentiscus*, *Rosmarinus officinalis*, *Cistus albidus*, *Cistus* cf. *salvifolius*, 100 m, 15.11.1994, leg. J.L. Siquier F-2G (BCC-MPM 1969); 2551.- Ibiza, Zona entre Santa Gertrudis y Sant Mateu d'Aubarca, *Pinus halepensis*, *Juniperus phoenicea*, *Pistacia lentiscus*, *Cistus* sp., 100-200 m, leg. J.L. Siquier I-10G (BCC-MPM 1960); 2553.- *Idem*, Siquier I-11G (BCC-MPM 1963). **SWEDEN**: 845.- Uppland, Lena Parish, 1 km NE of Storureta, in coniferous forest, 15.8.1973, leg. N. Lundquist 8601 (UPS, slide BCC-MPM 2046); 868.- Uppland, Älvkarleby, Älvkarleö, 11.9.1910, leg. R.E. Fries as *R. luteolus* (S); 869.- Uppland, Djurö sn, Runmarö, SÖ ändan av Vitträsk, vid alrötter, 19.7.1948, leg. G. Haglund & R. Rydberg, as *R. luteolus* Fr. (S); 870.- Småland, Femsjö sn, Femsjö, vid gamla vägen gångstigen, vid Elmhultsvägen mot Stubbebo, på liten stig i barrskog, 15.9.1948, leg. G. Haglund & S. Lundell, as *R. luteolus* Fr. (S); 871.- Gotland, Eke, 9.1895, leg. N. Broander, as *R. luteolus* Fr. (UPS); 872.- Uppland, Ultuna, 9.1889, leg. H. von Prost, as *R. luteolus* Fr. (UPS); 873.- Dalarne, Rättvik, 1866, leg. E.G. Thunell, as *R. luteolus* Fr. (UPS); 894.- *Idem* (UPS); 874.- Närke, Knista sn, Lekeberga, 13.9.1942, leg. E. Broddeson 111, as *R. luteolus* (UPS); 875.- Västmanland, Viker sn, Flyttkullen, vid stranden av Älvlången, bl. mossa i ett 5-10 tjockt jordlager på ett urkalkblock, 7.1961, leg. E. Persson, as *R. roseolus* (Corda) Th. M. Fr. (UPS); 876.- Södermanland, Björkvik sn, 10.1913, leg. T. Henschen, as *R. lute*olus Fr. (UPS); 877.- Södermanland, Åker sn, Marietorp, nära Mariefred, "en fot under jordytan", 1879, leg. C.A.V. Kallsterius, as *R. luteolus* Fr. (UPS); 878.- Södermanland, Stigtomta sn, kärr vid stranden av. Yngaren, 29.9.1961, leg. E. Julin (UPS); 879.- Gotland, Gnisvärd, glestallskog på sand, nära stranden, 30.9.1935, leg. B. Petterson, as *R. roseolus* (UPS); 880.- Uppland, Väddö parish, on the place for the former Lake Stensjön, 15.7.1959, leg. R. Santesson 12836, as *R. luteolus* Fr. (UPS); 881.- Gästrikland, Hille sn, Tolfforsskogen, ab. 2 km W.N.W of the manor of

Tolffors, close to the frontier to Gävle and Valbo, coniferous wood, 10.8.1957, leg. J.A. Nannfeldt, as *R. luteolus* Fr. (UPS); 882.- Åsele Lappmark, Kvarnberg, strax N om vägskäll till Oxberg, vägren vid granskogsbun, 3.9.1986, leg. A. Stina & R. Morander 5024, as *R. luteolus* Fr. (UPS); 883.- Dalarna, By sn, Berg, under tall och björk nära mosse, 8.1944, leg. G. Ståhlberg, as *R. luteolus* Fr. (UPS); 884.- Uppland, Österlövsta sn, Leyfstabruck, Hellbo, barrskoa, 10.1978, leg. J. Nordin, as *R. luteolus* (UPS); 885.- Gotland, Hogrän, 9.9.1948, leg. E.Th. Fries, as *R. roseolus* (UPS); 886.- Uppland, Häverö par., Medholmen, pine forest, 24.10.1980, leg. W. & R. Lindberg, as *R. luteolus* (UPS); 887.- Uppland, Stockholm, utanför Hornstull, V. om sjön Trekanten, mellan stubinfabricken och Blommensberg, 1875, leg. C.M. Groth, as R. luteolus Fr. (UPS); 889.- Södermanland, Huddinge, flemmingsberg, 2.10.1984, leg. A. Berg & V. Linde (S); 890.- Södermanland, Ösmo sn, Norvik, 31.7.1942, leg. S. Lundell & H. Persson, as *R. roseolus* (Corda) Th. Fr. (S); 891.- Uppland, Singö sn, Singö, nordligaste deten, 850 m SSV om Råstensuddens fyr., ca 150 m från stranden, svallad morän, barrskog med inslag av lövihäd, delvis exponerade i jordytan, 11.8.1979, leg. L.E. Kers, as *R. rubescens* Tul. (S); 892.- Uppland, Östhammar, leg. E. Nordström, as *R. luteolus* Fr. (UPS); 893.- Södermanland, Näshulta, 9.1943, leg. K. Ekdal (UPS); 896.- Tireden, Bodarme, skogsfow, 1882, leg. P.N. Berlin (UPS); 897.- Skåne, Åhus i tallplantering, 1887, leg. L.J. Wahlstest, as *R. roseolus* (Corda) Th.M. Fr. (UPS); 898.- Uppland, Östhammar, 28.8.1895, leg. E. Nordström, as *R. roseolus* (Corda) Th.M. Fr. (UPS); 899.- Gotland, Norrlanda socken, Sandbrunkar, på skogsttig,. 3.11.1967, leg. G. Eriksson, as R. vulgaris (Vitt.) M.L. Lange (S); 900.- Gotland, Norrlanda socken, Hammars, på stig nära sjön, 24.9.1966, leg. G. Eriksson, as R. vulgaris (Vitt) M. Lange (S). **SWITZERLAND**: 854.- Beatenberg, Berna, al bordo di bosco mixto di *Pinus* e *Picea*, terreno acido, 1500 m, 19.9.1990 (Lavorato 900910 29, duplex BCC-MPM 1507).

Extralimital collections. UNITED STATES: 660.- Oregon, Lincoln County, Yachats, Tillacum Camp, hypogeous under *Pinus contorta*, 16.10.1965, ex Herb. Trappe 381 (PRM 721460); 851.- *Idem* (C); 843.- Washington, Klickitat Co., Trout Lake, under yellow pine, 3.10.1964, leg. Oswalds (UPS, slide BCC-MPM 2014); 844.- Idaho, Kootenai Co., Coeur d'Alene, 12.10.1966, leg. A.H. Smith 74138 (UPS); 888.- California, San Francisco, Ingleside district, south of Golden Gate, under leaves, beneath eucaliptus and pine trees, 29.10.1904, leg. N.L. Gardner 208, as *R. provincialis* Tul. (S); 902.- North America, leg. C.G. Lloyd 6116, as *R. rubescens* (S); 906.- Washington, Cusik, Pend Oreille Co., in duff in coniferous woodland on fairly sandy soil, 8.10.1966, leg. K. Harrison ex Herb. Watling 38609 (E); 907.- *Idem*, ex Herb. Smith 74036 (E); 908.- New York, Monroe Co., Rochester, 10.1966, leg. W. Litten (E); 909.- Oregon, Fogarty Cr. St. Pk., near Lincoln City, under lodge pole pine, 28.10.1986, leg. R. Watling (E); 910.- *Idem* (E); 911.- Oregon, Devils Lake, under planted *Pinus contorta*, 28.10.1986, leg. R. Watling 19408 (E); 2358.- Idaho, Moscow, leg. L.F. Henderson 5168, HOLOTYPE (NY).

Rhizopogon ochraceorubens A.H. Smith

European collections. **BELGIUM**: 2158.- Lichtaart, Campine, 17.9.1956, leg. J.T. Palmer 661, as *R. luteolus* Fr. (K); 2159.- *Idem* (K). **NETHERLANDS**: 937.- Schiermonikoog Forest, 3.11.1975, leg. C. Bas 6747, as *R. luteolus* Fr. (L). **NORWAY**: 935.- Sör-Tröndelag, Rennebu, Berkåk, Buvatnet, UTM NQ56, 420-430 m, 13.8.1961, leg. K. Brandtzæg, as *R. rubescens* (Corda) Th.M. Fr. (TRH); 936.- Nord-Tröndelag, Namsskogan, 1972, leg. Å. Erlandsen, as *R. rubescens* Tul. (TRH); 938.- Sör-Tröndelag, Trodheim, Myrsund, på skogsveg, UTM 52NE, 6.8.1977, leg. S. Sivertsen, as *R. luteolus* Fr. (TRH). **SWEDEN**: 920.- Uppland, Ultuna, coniferous forest, 17.9.1992, leg. D. Luoma & MPM (BCC-MPM 1561); 921.- *Idem* (BCC-MPM 1562); 940.- Västergotland, Göteborg, Timmerås, 8.1902, leg. A. Södergren, as *R. luteolus* Fr. (LD); 941.- Uppland, Stockholm, utanför Hornstull, W. om sjön Trekanten, 1875, leg. C.M. Groth, as *R. luteolus* Fr. (GB); 942.- Öland, Böda sn, Grankullavikens pensionat, på badudden, i gräs under tallar vid stranden, 14.9.1950, leg. G. Haglund & E. Hulten, as *R. lutescens* Fr. (S). **UNITED KINGDOM**: 929.- Scotland, Culbin Sands, amongst plantation pine (*Pinus sylvestris*), exposed in sandy soil, 27.9.1963, leg. R. Watling 544, as *R. luteolus* (E); 930.- *Ibidem*, 8.1967, leg. L. Hawker ex Herb. Watling 5324, as *R. luteolus* (E); 931.- *Ibidem*, under Pinus nigra, 8.9.1975, leg. R. Watling, as *R. rubescens* 11385 (E); 932.- *Ibidem*, under pines in huge troops, track side, pushing up (thru?) sand, 6.9.1988, leg. R. Watling 20755, as *R. luteolus* (E); 933.- *Idem*, leg. Watling 20759 (E); 934.- *Ibidem*, under pines, 6.9.1988, leg. R. Watling 20756, as *R. luteolus* (E); 2160.- *Ibidem*, under *Pinus* sp., 8.1959, leg. S.A. Hutchinson, ex Herb. Palmer 960, as *R. luteolus* Fr. (K); 939.- England: New Forest, 10.1899, leg. C.B. P., as *R. rubescens* (DBN)

Extralimital collections. MEXICO: 923.- Puebla, Huanchinango a Necaxa, bosque de *Pinus*, 4.7.1960, leg. G. Guzmán 2340-A (LG). UNITED STATES: 922.- Idaho, Valley Co., Payette nacional Forest, Twin Lakes Road, under mixed conifers, 20.7.1957, leg. A.H. Smith 59057, PARATYPE of *R. ochraceorubens* A. H. Smith (E); 924.- North Carolina, Carteret Co., Newport, pine forest, in the ground, partly exposed by animals, 15.1.1967, leg. J. Kohlmeyer (LG, duplex BCC-MPM 1449); 925.- North Carolina, Carteret Co., Broad Creek, 14.10.1969, in sand near edge of *Zoysia* grass turf, under *Pinus taeda* and next to several *Ericaceae*, *Magnolia virginiana*, *Quercus*, etc., 14.10.1969, leg. J. Kohlmeyer 2638 (LG, duplex BCC-MPM 1448); 926.- *Idem* (UPS); 927.- New Mexico, Los Alamos Co., Los Alamos, under ponderosa pine, 27.9.1967, leg. K. A. Harrison 7203 (UPS); 928.- Oregon: Cascades, Indian Fort, 23.9.1977, leg. A. Bresinsky (M).

Rhizopogon pannosus Zeller & Dodge

European collections. **AUSTRIA**: 952.- NÖ, Neunkirchen, Mollram, unter *Pinus nigra*, 22.5.1987, leg. W. Klofac, as *R. roseolus* (Corda) Th.M Fries (WU 6023). 953.- *Idem* (WU). **SPAIN**: 951.- Teruel, Nacimiento del Tajo, 3.6.1988, leg. F.D. Calonge (BCC-MPM 1690).

Extralimital collections. UNITED STATES: 950.- California, Mariposa Co., growing in trampled roadway, 7.1916, leg. W.A. Sitchell, HOLOTYPE [half fruitbody] (NY, slide BCC-MPM 2186); 2315.- *Idem*, two fragment of the holotype (FH); 2316.- Washington, Bingen, leg. W.N. Suksdorf, ex Herb. Lloyd 5603, PARATYPE (BPI); 2317.- *Idem*, ex Herb. Lloyd 1029, PARATYPE (BPI).

Rhizopogon rocabrunae M.P. Martín

European collections. **SPAIN**: 1977.- Girona, Campelles, Pla de Prats (Ripollès), bajo *Abies alba*, 1570 m, 28.5.1994, leg. A. Rocabruna, M. Tabarés & J. Vila, PARATYPE [collected to 200 m of the holotype] (BCC-MPM 1985); 2435.- *Idem*, HOLOTYPE (BCC-MPM 1862).

Rhizopogon roseolus (Corda) Th.M. Fr.

A.- Collections with spore volume inferior to 22.5 mm^3.

European collections. **AUSTRIA**: 1830.- NÖ Gmünd, SG Breitensee, sub *Picea*, im sand, 490 m, 22.9.1984, leg. L. Sandmann & A. Hansknecht (WU 6619); 1832.- *Idem*, 6.10.1985, leg. Singer et al. (WU 6620); 1833.- NÖ Gmünd, SG Kleineibenstein, sand, 21.9.1984, leg. L. Sandmann & A. Habsknecht (WU 4509); 2035.- Mähren, Gemeidewald nordwestl von Waldboden halb unterirdisch, 28.9.1933, leg. Canon as *R. rubescens* Tul. (W 15129); 1870.- Kärnten, 9.1902, leg. Nießl, as *R. rubescens* Tul. (M); 1871.- Wienerwald, 1913 ex Herb. Höhnel, as *R. rubescens* Tul. (M); 2036.- Tirol, Toblacher, unter Nadeln im *Pinus sylvestris*, 6.1924, leg. K. Keissler, as *R. rubescens* Tul. (W 6804); **BELGIUM**: 1843.- Aarschot, dans la terre sablonneuse des sapinières, 11.1883, leg. E. Marchat, as *Rhizopogon rubescens* Tul. (Roumeguère, Fungi Gallici exsiccati 2811) (DBN); 1968.- *Idem* (UPS); 1997.- *Idem* (BP 22312); 2005.- *Idem* (G); 2082.- *Idem* (CUP). **CZECH REPUBLIC**: 2015.- In piceto prope Loučky haud procul Konstantinovy Lázně, 7.10.1969, leg. A. Pilát, as *R. vulgaris* (Vitt.) M. Lange (PRM 682331); 2016.- Radotín, in Piceto, 26.11.1950, leg. V. Vacek, as *R. provincialis* Tul. (PRM 619015); 2017.- Všeradice (Bohemia), in silva coniferacea, 5.10.1949, leg. A. Doubová, as *R. provincialis* Tul. (PRM 619011); 2018.- Kacina (Bohemia), 1856, leg. Peyl, as *R. niveus* Rabenh. (PRM 704240); 2019.- Řevnice (Bohemia), in silva coniferacea (*Picea excelsa*, *Pinus sylvestris*), 6.10.1945, leg. V. Vacek, as *R. luteolus* Fr. (PRM 618924); 2020.- Vyškov, Kzálovopoloké

Vázany, in silva mixta, 18.9.1955, leg. Ondrousek, as *R. tenuisporus* Vel. (PRM 618940); 2021.- Bohemia merid., Sudomerice-Nemysl, in silva conif., 16.7.1950, leg. B. Svrcková & M. Svrček, as *R. tenuisporus* Vel. (PRM 618941); 2022.- Hvozdy pr. Davle, in pineti, 7.10.1945, leg. Dostál, as *R. tenuisporus* Vel. (PRM 618936); 2023.- Soběslav-Blata, in silvis turfosis, 6.1932, leg. A. Pilát, LECTOTYPE of *R. tenuisporus* Vel. (Hymenomycetes Cechosloveniae exsiccati) (PRM 19570; 2024.- *Idem*, SINTYPE of *R. tenuisporus* Vel. (PRM 154619); 2025.- Hradištko (Bohemia), 6.8.1950, leg. A.Dvorák, as *R. provincialis* Tul. (=*R. globatus* Vel.) (PRM 619012); 2033.- Mähren, Gemeidewald nordwestl, von Begersdorf (Iglau), im Waldboden halb unterirdish, 28.9.1993, leg. Canon, as *R. rubescens* Tul. (W 15132); 2053.- Stern prope Pragan, ex Herb. Montagne, as *R. luteolus* Fr. (PC). **Denmark**: 1853.- Sjælland, Tisvilde Hegn, on sandy road, (Henning Knudsen's letter -9.11.1992-: this locality is very characteristic with poor sandy soil and conifers, mostly *Picea abies* and *Pinus sylvestris*) 3.11.1947, leg. M. Lange, as *R. roseolus* (Corda) Hollos (C); 1855.- *Ibidem*, 10.1948, leg. B. Hansen (C); 1856.- *Ibidem*, 11.10.1947, leg. M. Lange, as *R. vulgaris* (Vitt.) Lange (C); 1857.- *Ibidem*, 19??, leg. M. Lange, as *R. rubescens* Tul. (C); 1858.- *Ibidem*, 5.10.1948, leg. M. Lange, as *R. vulgaris* (Vitt.) Lange (C); 1859.- *Ibidem*, 3.10.1947, leg. M. Lange, as *R. vulgaris* (Vitt.) Lange (C); 1861.- *Ibidem*, 11.10.1947, leg. M. Lange, as *R. vulgaris* (Vitt.) Lange (C); 1862.- Bornholm, Ronne Nordskov ved Skovly, one specimen on a sandy path with Carex arenaria, Cladonia and *Pinus sylvestris*, 17.8.1977, leg. T. Borgen, as *R. vulgaris* (Vitt.) M. Lange (C); 2031.- Denmark, leg. M. Lange, ex Herb. Hawker 23 (K). **Estonia**: 2075.- Hiiumaa, Köpu, ad terram arenosam, 29.9.1991, leg. L. Järva, as *R. vulgaris* (TAA 158013); 2076.- Pärnu, Lemme, 30.9.1982, leg. L. Järva (TAA 93713); 2077.- Lääne-Virumaa, Sagadi, ad terram in pineto-vaccinioso, 15.9.1959, leg. K. Kalanees (TAA 1263); 2078.- Hiiumaa, Sarve, ad terram arenosam, 2.9.1985, leg. L. Järva & H. Rebassoo, as *R. vulgaris* (Vitt.) M. Lange (TAA 93817). **Finland**: 1813.- Tavastia borealis, Jyväskylä, 1868, leg. J.F. Canth, as *R. rubescens* Tul. (UPS); 1985.- Ostrobottnia borealis, Rovaniemen rural commune, Hirvas, the forest school Rovaniemen metsäopisto, Grid 27° 7370:429, 8.9.1969, leg. E. Kankainen (TURKU 16661); 1986.- Regio aböensis, Koski Tl commune, Hongisto, dry heath forest of *Pinus sylvestris*; forest track, in sand, under *Pinus sylvestris*, Grid 27° 672872:28945, 6.10.1990, leg. P. Heinonen, as *R. luteolus* (TURKU 101632); 1987.- Ostrobottnia borealis, Oulunsalo commune, Koppana, dunes, Grid 27° 720:41, 18.9.1963, leg. M. Eriksoon (TURKU 27702); 2055.- Ostrobottnia media, Haapavesi, Mieluskylä, Tiiton lähde, 13.9.1970, leg. P. Koskela (OULU); 2056.- Lapponia kemensis, Sodankylä, Raudanjoki, Rimpilammet, pine heath between the road and the pools, Grid 27°E 7434:472, 3.9.1970, leg. M. Ohenoja, as *R. rubescens* Tul. (OULU); 2057.- Ostrobottnia borealis, Keminmaa, Kallinkangas, SW of the ridge, protection area, margin of pine bog, Grid 27°E 73048-9:3863, 27/28.8.1991, leg. V. Tammilehto (OULU); 2058.- Ostrobottnia borealis, Tervola, Kätkäjärvi, roadside in pine forest NW of Perälanmit ponds, numerousm, Grid 27°E 7350:408, 17.9.1986, leg. T. Ulvinen (OULU); 2059.- Lapponia enontekiënsis, Enontekiön Lappi, Enontekiö, Kuttanen, ca. 250 m N of the junction of the Kultima road, pine (*Pinus sylvestris*) dominated heath forest on sandy soil (of *Cladina* type with *Betula pubescens*), Grid 27°E 7596: 329, 320 m, 5.8.1977, leg. K. Metsänheimo, as *R. luteolus* Fr. (OULU); 2060.- Regio kuusamoënsis, Kuusamo, Oulanka national park, sandy bank of path in pine forest between road and Kiutaköngäs falls, Grid 27°E 7365:604, 10.9.1970, leg. T. Ulvinen & H. Harmaja (OULU); 2061.- Ostrobottnia borealis, Liminka, Rantakylä, pine forest of *Empetrum-Vaccinium vitis-idaea* Type (EVT) near sand pit, sandy track, Grid 27°E 7190:421, 29.9.1980, leg. J. Lumme (OULU); 2062.- Ostrobottnia borealis, Oulu, Nokelankangas, old sand pit near childrens Hospital, Grid 27°E 7210:430, 9.1964, leg. T. Ulvinen, as *R. rubescens* Tul. (OULU); 2063.- Ostrobottnia borealis, Oulu, Nokela, SE of the Joulumerkkikodin, one specimen, grid 27°E 7210:430, 7.9.1962, leg. T. Ulvinen (OULU); 2064.- Ostrobottnia borealis, Pudasjärvi, Ala-Livo, E of Männkönlanspi (pond) in sandy soil along track through heathy conifer forest, Grid 27E 7264:489, 4.8.1976, leg. T. Ulvinen (OULU); 2065.- Lapponia kemensis, Kittilä, Raattama, heathy ground just SE of the mouth of the Saivojoki (=stream) between the road and the

Ounasjoki (river), heathy pine forest, Grid 27°E 7561:388, 240 m, 27.7.1977, leg. M. Ohenoja (OULU); 2066.- Ostrobottnia media, Haapavesi, Mammo, on trail through heathy forest about 200 m W of Vapunsaari cabin, Grid 7115: 399, 11.10.1969, leg. P. Koskela (OULU); 2067.- Ostrobottnia media, distric of Raahe (Raahensalo), gravelly road bank, Grid 27° E 717:37, 5.9.1973, leg. Anonymous (OULU);2068.- Lapponia kemensis, Kittilä, about 1 km E of the church village, pine (*Pinus sylvestris*) dominated forest (of *Myrtillus-Calluna-Cladina* type with *Betula pubescens* and *Picea*), Grid 27°E 7510:412, 175 m, 9.8.1977, leg. K. Metsänheimo, as R. luteolus Fr. (OULU); 2115.- Nylandia, Heinlahti, nurmettunut peltotie (voitattien joukossa), 8.9.1973, leg. H. Teerikorpi (H); 2116.- Savonia australis, Ruokojärvi, SE of the lake Keplakko, between the main road and the lake Haukilampi, Rohvostinrinne, dry, half-open, pure pine heath forest, on tracks, Grid 27° E 6869: 607, 95 m, 15.8.1987, leg. I. Kytövuori 87492 (H); 2117.- Tavastia orientalis, Sopenkorpi, Palokunnantie kulttuurivaikutteinen harjumännikkö, neulas/lehtikarikkeessa (Helvella elastica), Grid 27° E 6763: 425, 27.9.1992, leg. V. Haikonen 14686, as *R. rubescens* (H); 2118.- Satakunta, Hämeenkangas, in pineto sicco, 9.10.1940, leg. M. Laurila (H); 2119.- Regio kuusamoënsis,Kuusamo, 24.7.1963, leg. H.T. Toppari, as *R. rubescens* Tul. (H); 2120.- Tavastia australis, Kutajoki, Vehkasaari, VT heath forest with *Pinus sylvestris*, in a path, 22.8.1967, leg. H. Harmaja & O. Kärki (H); 2121.- Karelia australis, Pyhältö, Kettumäki, tallhed, 5.9.1980, leg. B. Fagerström, as *Scleroderma* (H); 2122.- Ostrobottnia borealis, Rovaniemi comm., Pisavaara Strict Nat. Res., Sorvalampi E side, on path, old *Pinus sylvestris* dominated forest, 6.9.1989, leg. H. Kotiranta 7857, as *Elaphomyces* (H); 2123.- Tavastia australis, Liesjärvi, Liesjärven kansallispuisto, Tervaharju, dry pine heath forest, Grid 27° E 6731: 330, 2.10.1983, leg. I. Kytövuori 83631 (H); 2124.- Savonia australis, Villmanstrand (=Lappeenranta), nya kyrkogård, 9.1898, leg. M. Buch, as *R. rubescens* Tul. (H); 2125.- *Ibidem*, tallmosand, 14.9.1989, leg. A. Ståhle, as *R. rubescens* Tul. (H); 2126.- *Ibidem*, sandmo i närheten av lägerfält, 14.9.1894, leg. A. Ståhle (H); 2127.- *Ibidem*, 1898, leg. M. Buch, as *R. rubescens* Tul. (H); 2128.- *Ibidem*, närheten av lägerfältet å sandmo, 14.9.1894, leg. A. Ståhle, as *R. rubescens* Tul. (H); 2129.- Tavastia australis, Syrjä, 23.9.1887, leg. A. Karsten 3699, as *R. rubescens* Tul. (H); 2130.- Nylandia, Ingå, Fagervik, i parken, 9.1897, leg. Hisinger (H); 2131.- Regio aboënsis, Bromarv Framnäs, 19.6.1952, leg. R. Tuomikoski (H); 2132.- Regio aböensis, Vihti, Haapakylä, Luontola tallskog-park i örtvegetation, löst liggande på marken, 1.9.1957, leg. N. Malmströn (H); 2133.- Regio aboënsis, Finby, Finnarv, 9.1921, leg. Elfving (H); 2134.- Regio aboënsis, Korpo, 28.9.1941, leg. Ole Eklund, as *R. rubescens* Tul. (H); 2135.- Nylandia, Espoo, Mustalampi-Haukkalampi ulkoilulalue, Siikajärveltä polku, polun varressa alkup, 26.8.1984, leg. A. Saari, as R. rubescens (H); 2136.- Nylandia, Borgå (=Porvoo) socken, Vessö, på tallrötter, 8.1932, leg. W. Nyberg, as *R. rubescens* Tul. (H); 2138.- *Ibidem* 2136, nära tuberkulossjukhuset, vid tallrötter i sandmark, 18.9.1935, leg. W. Nyberg, as *R. rubescens* Tul. (H); 2137.- Nylandia, Grankulla (=Kauniainen), sandmark i barrskog, Grid 27°E 667-68: 37, 20.8.1943, leg. W. Nyberg, as *R. rubescens* Tul. (H); 2143.- Regio aboënsis, Kemiö, Pederså, ca 1 km S of the village, from the grid number 68 towards W to the field area of Trankärret, at the limestone seam with numerous small quarries, rocky pine forest, Grid 27°E 6674:267, UTM EM3, 35 m, 21.9.1990, leg. I. Kytövuori 90-1843, as *R. luteolus* (H); 2144.- Regio aboënsis, Parainen, Attu, an der Strasse, 1.8.1953, leg. O.V. Schulmann, as *R. luteolus* Fr. (H); 2145.- Nylandia,Tusby, Klemetskog, 12.9.1941, leg. E. Häyrén, as *R. luteolus* (H); 2146.- Nylandia, Heinlahti, Hiekkainen kangas, mäntyjen alla, 4.10.1971, leg. H. Teerikorpi, as *R. luteolus* (H); 2147.- Tavastia australis, Syrjä, ås subterr., 17.9.1870, leg. P.A. Karsten, as *R. luteolus* (H). **FRANCE**: 1782.- Nogent-sur-Vernisson, "Arboretum des Barres", conifère, 12.10.1988 leg. Mornand 8822 G (duplex BCC-MPM 1716); 1783.- France, 7.12.1973, Herb. Lodz, as R. briardi Boud. (duplex BCC-MPM 1698); 1785.- Nice, leg. Quèlet, as *R. provincialis* Tul. (UPS, slide BCC-MPM 2037); 1786.- *Ibidem* leg. Barla ex Herb. Bresadola, as *R. provincialis* Tul. (UPS, slide BCC-MPM 2024); 1787.- *Ibidem*, 1.1889, leg. Quèlet, as *R. provincialis* Tul. (UPS, slide BCC-MPM 2038); 1789.- Corse, dunes côtières de la baie de Calvi un peu à l'E de la ville, sous *Pinus pinaster* et *P. pinea*, UTM MN81, 5.10.1972, leg. V. Demoulin 4472, as *R. vulgaris* (Vitt.)

M. Lange s.l. (LG, slide BCC-MPM 1299); 1790.- *Ibidem*, dunes de la baie de Calvi, près du restaurant Chez Marie et du Club Olympique, pelouse des dunes entre les bungalows du club olympique près de *Pinus pinaster*, 22.12.1978, leg. V. Demoulin 5342, as *R. vulgaris* (Vitt.) M. Lange (LG, slide BCC-MPM 1300); 1796.- N.O. Perpignan, dans les schistes albiens de Mont-Pins, sous *Pinus halepensis*, 80 m, 15.4.1971, as *R. vulgaris* (Vitt.) M. Lange (LG, duplex BCC-MPM 1379); 1798.- Jard-mes, dans le sable des dunes parmis les petites mousses au ras de la falaise, 11.11.1979, leg. J. Mornand, as *R. vulgaris* (LG, slide BCC-MPM 1406); 1802.- Loire-Atlantique, Pen-Bron, dunes à *Pinus pinaster*, 17.12.1968, leg. M. Chassain, as *R. vulgaris* (LG, duplex BCC-MPM 1407); 1804.- A la sortie de St. Guilles-sur-Vie sur la route des Sables d'Olonne, dunes plantées de pins maritimes, avec Ephreda distachya, semihypogés, 23.10.1968, leg. V. Demoulin 3726, as *R. vulgaris* (Vitt.) M. Lange (LG, slide BCC-MPM 1404); 1805.- Pinete dei intorni di Nizza marittima, Autunno 1859, leg. Barla, as *R. provincialis* Tul. (Erbar. Crittogam. Ital 550) (SIENA); 1822.- *Idem* (PAV); 1964.- *Idem* (UPS); 2009.- *Idem* (G); 1812.- France, ex Herb. E. Fries, as *R. provincialis* (UPS); 1924.- Nice and Lenan, 12.1889, leg. Barla, ex Herb. Bresadola, as *R. provincialis* Tul. (S); 1925.- France, leg. Boudier, as R. provincialis Tul. (S); 1996.- Sur les talus sablonneux, sur le grès vosgien (Raon) et sur le grès rouge (Saint-Dié), 11.1894, leg. R. Ferry, as *R. luteolus* Fr. (Roumeguére, Fungi selecti exsiccati 6781) (BP 22294); 2048.- Hyères, 5.1898 ex Herb. Boudier, as *R. luteolus* (PC); 2049.- Cannes, leg. Rolland ex Herb. Boudier, as *R. luteolus* (PC); 2109.- *Ibidem* 2048, 9.1910, leg. M. Pierrhugues, as *R. provincialis* Tul. (PC); 2110.- Nice, 1861, leg. Barla, as *R. provincialis* Tul. (PC); 2112.- *Ibidem*, 11.1847, leg. Tulasne, as *R. provincialis* (PC); 2113 *Idem* (PC); 2111.- Trets (Bouches-du-Rhône), 12.1847, leg. Tulasne as *R. provincialis* (PC); 2395.- Trinité s/Mer, bord de mer sous *Pinus maritima*, 24.10.1986, leg. J.P. Priou 86719 (duplex BCC-MPM 1518); 2396.- Jard sur Mer, *Pinus*, *Cistus*, *Quercus ilex*, 11.11.1988, leg. J.P. Priou 88142 (BCC-MPM 1519); 1799.- # Casserle, 31.8.1968, as *R. vulgaris* (LG, slide BCC-MPM 1408). **GERMANY**: 1803.- Wildbahn bei Coburg, Mischwald, MTB 5731, 10.10.1977, leg. H. Engel D 93, as R. vulgaris (Vitt.) M. Lange (LG, slide BCC-MPM 1414); 1823.- Brandenburg, Sophienstädt bei Biesenthal, Nieder-Barnim, in sandigen Kiefernwäldern, 16.9.1912, leg. P. Sydow, as *R. provincialis* Tul. (Sydow, Mycotheca germanica 1061) (PAD); 1831.- *Idem* (WU); 1834.- *Idem* (FI); 1842.- *Idem* (DBN); 1846.- *Idem* (FR); 1847.- *Idem* (BUCM 66337); 1849.- *Idem* (C); 1891.- *Idem* (M); 1897.- *Idem* (HBG); 1926.- *Idem* (S); 1921.- *Ibidem*, 15.9.1912, leg. P. Sydow, as *R. provincialis* Tul. (S); 1969.- *Idem* (UPS); 2000.- *Idem* (BP 22301); 2032.- *Idem* (E); 2039.- *Idem* (W 1858); 2084.- *Idem* (CUP); 2108.- *Idem* (JENA); 1826.- Freiburg, 11.1866, as *R. rubescens* (STR); 1827.- Brandenburgia, in pinetis ad Sophienstadt prope Ruhlsdorf, leg. H. Sydow, as *R. provincialis* Tul. (Kryptogamae exsiccatae 2509) (WU); 1848.- *Idem* (BUCM 66336); 1864.- *Idem* (LD); 1874.- *Idem* (M); 1927.- *Idem* (S); 1991.- *Idem* (MA-Fungi 6065); 1998.- *Idem* (BP 19190); 1999.- *Idem* (BP 22303); 2008.- *Idem* (G); 2010.- *Idem* (G); 1828.- Königsbrück, Pulsnitz, 1879/80, leg. Staritz, as *R. luteolus* Tul. (WU); 1829.- In montibus prope Könisbrück et Pulsnitz, Saxoniae, Aestate et autumno 1879/80, leg. R. Staritz, as *R. luteolus* Tul. (Rabenhorst-Winter, Fungi europaei 2640) (WU); 1852.- *Idem* (C); 1884.- *Idem* (M); 1900.- *Idem* (HBG); 1902.- *Idem* (HBG); 1904.- *Idem* (HBG); 1905.- *Idem* (S); 1906.- *Idem* (S); 1967.- *Idem* (UPS); 1995.- *Idem* (BP 22292); 2012.- *Idem* (G); 2013.- *Idem* (G); 2040.- *Idem* (W); 2083.- *Idem* (CUP); 2097.- *Idem* (JENA); 2099.- *Idem* (JENA), [Together with a sample of *Gautieria pallida* (Harkn.) Harkn.]; 2100.- *Idem* (JENA); 2140.- *Idem* (H); 1837.- Greiz, Thüringen, bei Neugernsdorf, 9.1986, leg. H. Blase (LZ 3411); 1838.- Württemberg, Backnang, Mischwald, Lehmboden, 18.8.1973, leg. Baschin, as *R. vulgaris* (Vitt.) M. Lange var. *vulgaris* (Groß 552); 1850.- Pulsnitz, Saxony, 9.1880, leg. R. Staritz, as *R. rubescens* Tul. (C); 2096.- *Ibidem*, 1879-1880, leg. Staritz (JENA); 2101.- *Idem* (JENA); 2102.- *Idem* (JENA); 2103.- *Idem* (JENA); 2104.- *Idem* (JENA); 1863.- Giessen, 26.5.1863, as *R. rubescens* Tul. (RO); 1869.- Neustadt-Haardt, Trippstadt, Karlstadt, 17.3.1921, leg. F. Vill ex Herb. Soehner 1203, as *R. rubescens* Tul. (M); 1875.- Homburg Saar, Waldkiefer, Bundtsandstein, 7.9.1968, leg. G. Groß, as *R. vulgaris* (Vitt.) M. Lange (Groß 215); 1879.- *Idem*, ex Herb. Groß 94 (M); 1880.- M-Weisskirchen,

Ynabnoka, im Nadeluald, 9.1926, leg. F. Petrak, as *R. vulgaris* (Vitt.) M. Lange (M); 1881.- Bayer-Oberpfalz, Klardof, Sumpfgebret, 26.8.1915, leg. S. Killermann, as *R. luteolus* od graveolens (M); 1883.- Mittelfrankem, kr. Hersbuck, Leutensbach, Probsteiholz, 25.9.1946, leg. S. Starcs, as *R. luteolus* Fr. (M); 1912.- *Idem* (S); 1885.- Paar, umgebung von Augsburg, 8.9.1962, leg. J. Stangl, as *R. rubescens* Tul. (M); 1886.- Ansbach, 25.9.1935, leg. S. Killermann, as *R. rubescens* (M); 1887.- Sauerlach, Fichtenwald, 10.1919, leg. Soehner, as *R. rubecens* Tul. (M); 1888.- Unterfranken, Gemünden, Ständelberg, Karst, unterer Muschelkalk, *Corylus*, *Quercus*, *Pinus*, MTB 5924, 25.9.1982, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 1889.- Wiesau Opf., 9.1-46, leg. S.Schwandner, as *R. aestivus* Wulf. (M); 1890.- Oberpflaz, Kornthau, 2.9.1913, leg. S. Killermann, as *R. rubescens* v. *vittadini* (M); 1892.- Schwaben, Derchinger Forst bei Augsburg, 10.1960, leg. H. Stangl, as *R. vulgaris* (Vitt.) M. Lange (M); 1895.- Westfalen, 1881 (HBG); 1903.- Berlin, 20.10.1882, leg. P. Magnus, as *R. luteolus* Fr. (HBG); 1929.- Kampem bei Bozee, 600 m, 9.1907, as *R. rubescens* Tul. (S); 2003.- Ca. Budenheim, in pinetis, raro, Autumno, ex Herb. Fuckel, ex Herb. Barbey-Boissier, as *R. virens* Fr. (Fungi rhenani 1252) (G); 2004.- *Ibidem*, Autumno, ex Heb. Fuckel, ex Herb. Barbey-Boissier, as *R. rubescens* Tul. (Fungi rhenani 1251) (G); 2038.- *Idem* (W 11126); 2012.- In monte Oelberg, in pinetis, raro, Autumno, es Herb. Fuckel, ex Herb. Barbey-Boissier, as *Rhizopogon luteolus* Fries (Fungi rhenani 1250) (G); 2070.- Leuchtenberg, unter Kiefern, 29.9.1909, leg. S. Killermann, as *R. virescens* (M); 2071.- Oberpfalz, Roding, Kiefer + Fichten, Sommer 1949, leg. Walter, ex Herb. Soehner 2258, as *R. angustisepta* Z.& D. (M); 2072.- Nürnberg, Kiefernwälder, Sommer 1925, leg. Anton Seidl, ex Herb. Soehner 1149, as *R. piceus* ?, *R. angustisepta* ? (M); 2105.- Waldenburg, *Picea*, 5.9.1946, leg. P. Ebert, as *R. rubescens* Tul. (JENA); 2106.- Colditz, Colditzer, 26.6.1949, leg. G. Melzer, as *R. rubescens* Vitt. (JENA); 2107.- Ca. 2 Km NO von Beelita bei Potsdam, sandiger Kiefernwald (*Pinus sylvestris*), 16.10.1971, leg. D. Zeise & G. Hirsch (JENA); 1781.- Germany (MA-Fungi 6065, duplex BCC-MPM 1697); **Italy**: 1775.- La Sila, Cosenza, bosco puro di *Pinus laricium*, terreno ácido, 27.10.1984, leg. C. Lavorato 841027-19 (duplex BCC-MPM 1504); 1824.- Como, presso Rodero, 400 m., Autunno 1929, leg. O. Mattirolo, as *R. rubescens* Tul. (VER); 1877.- *Ibidem*, 9.1924, as *R. vulgaris* Vitt. (M); 1836.- Südtirol, Antholzer Tal, *Picea abies*, 7.1988, leg. Wefing, as *R. vulgaris* (Vitt.) M. Lange (Groß 1110, slide BCC-MPM 2068); 1873.- Como, 9.1924, leg. S. Killermann, as *R. vulgaris* (M); 1898.- Bozen, 30.5.1913, as *R. aestivus* Wulf. (HBG 25/1336); 1923.- Mendola, in abiegny, 1904, leg. G.Bresadola, as *R. provincialis* Tul. (S); 1949.- Varenna, in pinety et abiety, 1909, leg. Bresadola, as *R. virens* (Alb. & Schw.) Fr. (S); 2081.- Lido di Classe, nabij Ravenna, onder *Pinus pinea* aanplant, in grof schelpenrijk duinzand, 29.9.1981, leg. H.A. van der Aa (Vries 1013); 1882.- # In nandina Tridenti, 8.10.1924, ex Herb. Bresadola 1811, as *R. vulgaris* (Vitt.) Bres. (M); 1920.- # Sopramonte, in pinetis, 9.1897, leg. Lazzari, as *R. provincialis* Tul. (S); 1956.- # *Ibidem* 1920, 7.1894, leg. Bresadola (S). **Netherlands**: 1844.- # St. Michielsgestel, 10.1949, leg. J. Daams, as *R. rubescens* (L); 1845.- # *Ibidem* 1844, 22.10.1949, leg. Westmijze (L). **Norway**: 1806.- Hedmark, Folldalsverk, leg. A. Blytt (UPS); 1817.- Telemark, Bolkesjø, 11.8.1895, leg. R.E. Fries, as *R. rubescens* (UPS); 1840.- Hedmark, Alvdal, near Auma st., barskog, UTM NQ 80, 4.8.1970, leg. O. Gjærevoll, as *R. vulgaris* (Vitt.) M. Lange (TRH); 1974.- Hedmark, Folldalsverk, under *Pinus* and amnong Antennaria dioeca, 9.8.1986, leg. M. Jeppson (Jeppson 2160); 1988.- Sogn og Fjordane, Stryn hd. Stryn, Årheimsfjellets nordride, Epiquish i yattig gråoskog, 26.8.1976, leg. E. Fremstud (BG); 1989.- Sogn og Fjordane, Sogndal, Kampanque, Oygardsfeldet, 14.9.1975, leg. Å. Hermansen (BG). **Poland**: 1896.- Breslau, 10.1872, leg. L. Becker, ex Herb. Winter, as *Hymenangium virens* Klotzsch. (HBG); 2139.- Kampinoski Park Narodowy, Truskaw, ad arenosos apricosque ad pineti marginem, 20.9.1960, leg. W. Rudnicka-Jezierska, as *R. luteolus* Fr. et Nordh emend tul (Planta Varsavienses Exsiccatae 24) (H). **Portugal**: 1801.- Beira Alta, au SW de Celorico da Beira sur la N17, pente granitique sous *Pinus pinaster*, 23.12.1975, leg. V. Demoulin 4199, as *R. vulgaris* (Vitt.) M. Lange (LG, slide BCC-MPM 1413); 1936.- Madeira, on the road to the outlook Eiro do Serrado, 22.10.1975, leg. L.-Å. Gustafsson, as *R. vulgaris*

(Vitt.) M. (S); 1957.- S. Fiel, in pineti, 10.1902, leg. Torrens, as *R. provincialis* var. *minima* (S). **Russia**: 2073.- Carelia: Kalevala, pinetum racciniosum, 8.8.1965, leg. J. Maasik, as *R. vulgaris* (TAA 13499); 2074.- Carelia,Kalevala, Mikkola, pinetum cladinosum, 9.9.1965, leg. J. Maasik (TAA 18131). **Spain**: 1764.- Barcelona, El Far, Dosrius (Maresme), bosque *Quercus ilex*, *Q. pubescens* & *Pinus pinea*, 510 m, UTM DG50, 25.10.1984, leg. M.P.M. (BCC-MPM 81); 1765.- Barcelona, Begues (Baix Llobregat), bajo *Pinus halepensis*, 350 m., UTM DF07, 30.11.1984, leg. M.P.M. (BCC-MPM 157); 1767.- *Ibidem*, 17.11.1985, leg. A. Canals (BCC-MPM 544); 1768.- *Idem* (BCC-MPM 554); 1766.- Barcelona, Calamot, Cavà (Baix Llobregat), pinar, 265 m, UTM DF07, 10.11.1983, leg. X. Llimona (BCC-MPM 354); 1769.- Barcelona, La Rierada, Molins de Rei (Baix Llobregat), pinar, 100-200 m, UTM DF28, 5.12.1983, leg. A. Garriga (BCC-MPM 837); 1771.- Barcelona, Sant Martí de Montnegre (Vallès Oriental), in mediterranean vegetation (*Quercus*, *Castanea*), 30.10.1985, leg. A. Rocabruna (BCC-MPM 1685); 1772.- Barcelona, Fons del Fangar, under *Pinus* on calcareous soil, leg. M. Jeppson, 31.10.1985 (BCC-MPM 1686); 1773.- *Idem* (BCC-MPM 1687); 1774.- Barcelona, Can Puigdemir, Vallgorguina (Vallès Oriental), *Pinus radiata*, 17.5.1988, leg. J. Llistosella (BCC-MPM 997); 1776.- Girona, Gatosa d'en Riusec, Llagostera (La Selva), bajo *Quercus suber*, 2.12.1992, leg. D.Sierra, A. Sánchez & M.P.M. (BCC-MPM 1589); 1777.- *Idem* (BCC-MPM 1593); 1778.- Girona, Sant Hilari Sacalm (La Selva), 4.11.1987 (BCC-MPM 838); 1779.- Salamanca, Vitigudino, 24.11.1990, leg. F.D. Calonge (BCC-MPM 1689); 1780.- Mallorca, Marjanó, Escorca, 17.2.1988, leg. J.L. Siquier (BCC-MPM 1696); 1784.- León, Ponferrada, Toreno, Santa María, en bosque *Pinus*, *Quercus* y *Castanea*, 19.11.1989, leg. T. Pérez (BCC-MPM 1703); 1797.- Tenerife, Valle de la Orotova, entre Realejo Alto et Icod Alto, sous *Pinus canariensis*, 550 m, 31.3.1972 ex Herb. Demoulin 4282, as R. vulgaris (Vitt.) M. Lange (LG, slide BCC-MPM 1411); 1800.- Málaga, Entre Fuengirola et Marbella, maquis sur roche cristalline, *Lavandula*, *Cistus monspeliensis* à prox. de *Pinus halepensis* et *Eucalipthus*, 31.12.1975, leg. V. Demoulin 4221, as *R. vulgaris* (Vitt.) M. Lange (LG, duplex BCC-MPM 1410); 1978.- Tenerife, 0.9 km west of intersection to Las Raices, hypogeous under *Pinus canariensis*, 1150 m, 29.12.1976, leg. R.P. Korf, R. Fogel, G.L. Hennebert, L.M. Kohn, as *R. vulgaris* (Vitt.) M. Lange (Mycoflora of Macaronesia 1236) (CUP); 1979.- *Idem* (Mycoflora of Macaronesia 1237) (CUP); 1980.- *Idem* (Mycoflora of Macaronesia 1238) (CUP); 1981.- *Idem* (Mycoflora of Macaronesia 1235) (CUP); 1982.- *Idem* (Mycoflora of Macaronesia 1241) (CUP); 1983.- Hierro, at km mark 24 between San Andrés and Fuente, hypogeous unde *Pinus* sp., 1300 m, 8.1.1977, leg. R.P. Korf, R. Fogel, G.L. Hennebert, L.M. Kohn, as *Rhizopogon vulgaris* (Vitt.) M. Lange (Mycoflora of Macaronesia 1438) (CUP); 1984.- Hierro, 9 km toward Cruz de los Humilladeros from interseccion near Fuente, emergent under *Pinus* sp., 8.1.1977, leg. R.P. Korf, R. Fogel, G.L. Hennebert, L.M. Kohn, det. R. Fogel as *R. vulgaris* (Vitt.) M. Lange (Mycoflora of Macaronesia 1442) (CUP); 1990.- Ávila, Piedralaves, zona 4, 6.11.1984, leg. F.D. Calonge (MA-Fungi 8170); 1992.- Tenerife, pinar de los Realejos, viviendo entre las acículas del pinar, 19.11.1978, leg. A. Bañares (MA-Fungi 1949), 1993.- Huelva, Doñana, pinar del Martinazo, 23.3.1977, leg. F.D. Calonge (MA-Fungi 179); 2026.- Hierro, Pista de la Peña a Olla de San Miguel, terrícola entre acículas de pinos, 2.1.1976, leg. A Zugaza, W. Wilpret & A. Bañares (TFC Mic 813); Tenerife: Pinar de El Realejo, 26.12.1975, leg. E. Beltrán & J.L. Rodríguez (TFC 711); 2041.- Mallorca, Selva, Sa Comuna de Caimari, *Pinus halepensis* y *Ampelodesma mauritanica*, en zona quemada en junio de 1992, 300-350 m, 15.12.1992, leg. J.L. Siquier 121G (duplex BCC-MPM 1617); 2042.- *Idem*, leg. J.L. Siquier 122G (duplex BCC-MPM 1618); 2043.- Mallorca, Escorca, Predio Escorca, bosque mixto, 700-800 m, 8.11.1992, leg. J.L.Siquier 114G (duplex BCC-MPM 1622); 2044.- Mallorca, Escorca, Predio Manut, bosque mixto, *Rosmarinus*, *Mirtus*, *Erica* y musgo, 4.11.1992, leg. J.L. Siquier 113 G (duplex BCC-MPM 1623); 2045.- Albacete, Riopar, Campamento de San Juan (Sierra de Alcaraz), junto a *Pinus pinaster* en pinar aclarado, 1040 m, 18.11.1978, leg. M. Honrubia (MUB 1766); 2046.- Granada, Soportujar, pinar, 21.10.1979, leg. R. Galán & A. Ortega (GDAC 10596); 2047.- Córdoba, Cta. de Adamuz a Villanueva, bajo pinos, 29.11.1984, leg. A.J.G. Buendía & A.

Ortega (GDAC 21826); 2079.- Cádiz, Grazalema, bajo *Pinus sylvestris*, 5.199?, leg. B. Arroyo (BCC-MPM 1673); 2085.- Orense, Las Lamas, Candamia, *Pinus sylvestris*, suelo arenoso, 12.11.1989, leg. M. Duñabeitia (MA-Fungi 28343); 2087.- Cantabria, Castanedo, *Pinus radiata*, 100 m, 1.10.1986, leg. M. Dueñas & C. Colinas (MA-Fungi 28355); 2088.- *Ibidem*, *Pinus radiata*, 100 m, 1.10.1986, leg. C. Colinas (MA-Fungi 28356); 2089.- Pontevedra, Bueu, *Pinus pinaster*, parcela quemada, 22.11.1985, leg. I. Alvarez & C. Colinas (MA-Fungi 28357); 2093.- *Ibidem*, *Pseudotsuga menziesii*, plantación joven de 15 años, 5.11.1987, leg. R. Molina (MA-Fungi 28361); 2090.- Pontevedra, Bora, *Castanea sativa*, 27.11.1986, leg. C. Colinas (MA-Fungi 28358); 2091.- *Ibidem*, *Pinus pinaster* orientación SW, 4.11.1987, leg. I. Alvarez (MA-Fungi 28359); 2092.- *Ibidem*, *Pinus pinaster*, zona quemada, orientación W, 4.11.1987, leg. R. Molina (MA-Fungi 28360); 2094.- Soria, Navaleno, *Pinus sylvestris*, 11.11.1987, leg. J. Trappe (MA-Fungi 28362); 2095.- *Ibidem*, *Pinus sylvestris*, leg. R. Molina & X. Parladé (MA-Fungi 28363); 2148.- Barcelona, Vallgorguina, Can Vilà, *Pinus pinaster*, UTM 31T DG 5809, 350 m, 11.3.1994, leg. A. Sánchez (BCC-MPM 1797); 2164.- Canarias, as *R. webbi* (PC); 2165.- Canarias, ex Herb. Montagne, as *R. webbi* (K); 2166.- Canarias, ex Herb. Montagne, TYPE ? of *R. webbi* (K); 2388.- La Coruña,Santiago, Selva Negra, talud bajo pinos, 8.1.1977, leg. L. Freire (LOU-Fungi 598); 2389.- Lugo, Orbazay, 29TPH1462, 30.5.1981, leg. L. Freire & M. Castro (LOU-Fungi 591); 2390.- Pontevedra, Playa de Barra, 12.12.1987 (LOU-Fungi 3651); 2491.- Madrid, Guadarrama, 20.10.1990 (BCC-MPM 1976); 2494.- Pontevedra, El Grove, b/Eucaliptus, 29.11.1986, leg. F.D. Calonge; 2516.- Girona, La Bisbal, Riera Vilà (Baix Empordà), radura con cisti i pini, 100 m, 17.11.1993, leg. M. Sarasini (Sarasini 539); 2086.- # Asturias, Llaneces, *Pinus radiata*, 200 m, 14.5.1986, leg. J. Trappe (MA-Fungi 28354). SWEDEN: 1770.- Uppland, Edshammar, on a path, 9.9.1991, leg. M.P.M. (BCC-MPM 1464); 1807.- Närke, Örebro, 1870, leg. R.Hartman (UPS); 1808.- Närke, Ramundeboda sn, Laxå bruk, 4.9.1887, leg. P. Thorin, as *R. roseolus* (Cda.) Th. Fr. f. *amygdalodora* Th. Fr. (UPS); 1866.- *Idem* (GB); 1809.- *Ibidem*, 5.9.1887, leg. P. Thorin, as *R. rubescens* Tul. *amygdalodorus* Th. Fr. (UPS); 1810.- Närke, Hammar sn, Åmmeberg, 9,1912, leg. E.A. Fries (UPS); 1811.- Halland, Ö Karup sn, Hemmeslöus havsbad, torr tallskog, 6.9.1948, leg. B. Eriksson (UPS, slide BCC-MPM 2053); 1814.- Södermanland, Näshulta sn, Tallstugan, 9.1943, leg. E. Almquist (UPS); 1815.- Södermanland, Södertälje, 1908, leg. C.G. Lloyd (UPS); 1816.- Bohuslän, Orust, Morlanda i skogens, 4.9.1887, leg. P. Larsson (UPS, slide BCC-MPM 2054); 1818.- Närke, Karlskoga, Kortfors och Carlsdal 1887, leg. H. Ljunggren (UPS); 1819.- Jämtland, Bräcke sn, Bräcke, 8.1909, leg. T. Lagerberg (UPS); 1839.- Jämtland, Klövsjo, 22.7.1981, leg. Hintz, as *R. vulgaris* (Vitt.) M. Lange var. *vulgaris* (Groß 809); 1851.- Halland, Falkenberg, Gushwitz, as *R. virens* (Albertini et Schweiniz) (Schroeter, Pilze Schlesiens 1685) (C); 1860.- Skåne, Scania, Vomb parish, Vombs fure, Southeast of the inner parking-place at "Södra Vombvägen", in soil surface (± pure sand) at base of old big *Pinus sylvestris*, open south-exposed, 500 m, coordinates (Swedish grid: 2D4B1E71), 13.9.1987, leg. S. Svensson, as *R. rubescens* Tul. (LD); 1907.- Gotland, 1902, as *R. luteolus* (S); 1909.- Södermanland, Dalarö tratden, Östavall, 18.9.1886, L.E. Hagdahl (S); 1910.- Dalarna, Stora Tuna socken, Romme, Vid sandtag, 1.9 Km SSo om Stora Tuna kyrka, tallskog på grovmo, löst liggande i mopedbana i tallskogen, 12.9.1976, leg. Lars E. Kers, as *R. luteolus* Fr. (S); 1914.- Norrbotten, Övertoneå sn, ca. 2.5 km S om kyrkbyn, på stig i tallskog från stora vägen till gamla vägen, 2.9.1957, leg. O. Lönnquist 370 (UPS); 1915.- Närke, Hammar sn, Åmmeberg, 10.1912 leg. E.A. Fries (UPS); 1916.- Lule Lappmark, Jokkmokk sn, Muddus nationalpark, ca. 1 Km W om Nammates-stagan, på naken jord på stig, 2.8.1950, leg. J. Eriksson (UPS); 1917.- Dalarne, By sn, Norndals buks skogar, 13.9.1897, leg. A.F. Östberg (UPS); 1918.- Norbotten, Boden, Åberget, i sandkanten av. en skyttegrav, 14.10.1915, leg. E. Almquist (UPS); 1919.- Dalarna, Rättvik par., N.E. of Söderås, i spruce forest, 18.8.1965, leg. A. Harrison (UPS); 1928.- Uppland, Ultuna sn, Ö om Örsundsåan, nära Frysinge, Söder om Hårsbäcksdalens naturvårdsområde (vid Flostaåsen), mycket gammalt, igenväxande sandtag, på gammal körväg, i vägrenen och på mittsträgen, 29.7.1979, leg. L.-Å. Janzon, as *R. rubescens* Tul. (S); 1932.- Södermanland, Enskede, 9.9.1900, leg. L. Romell (S);

1933.- Uppland, Gustavsberg sn, Vik, 9.1887, leg. H. Kugelberg (S); 1935.- Småland, Femsjö sn, mellan L. Vallshult och Älmås, i djup barrblandskog, Elméns skifte, på skogsstig, i barr, 18.9.1948, leg. G. Haglund & S. Lundell (S); 1937.- Dalarna, "Hötjörn", 61°41'N 13°49'E (the locality not identified), 12.8.1981, leg. R.A. Hintz, as *R. vulgaris* (Vitt.) M. Lange (S); 1938.- Jämtland, Klövisjä, at the river Ljungan, appr. 14°1'E appr. 62° 41'N, 11.7.1981, leg. R.A. Hintz, as *R. vulgaris* var. *vulgaris* (Vitt.) M. Lange (S); 1939.- Uppland, Fasterna parish, SW of Kornamossen, ca. 10 Km NW of rimbo, on the small lumberroad running from E to W from the road between Råmäs and Storhammar, *Picea* forest, silty-sandy soil, 3.9.1984, leg. A. Anderberg, ex Herb. Kers 2027, as *R. vulgaris* (Vitt.) M. Lange (S); 1943.- Jämtland, Klóvsjö, 3 km E of highway, Kvärnsjö, 14°21'E 62°34'N, 22.7.1981, leg. R.A. Hintz, as *R. vulgaris* var. *vulgaris* (Vitt.) M. Lange (S); 1944.- Lappland, Jokkmokks socken, ca. 10 km S om Jokkmokk nära polcirkeln, tallskog med lingon, sanding jord, 28.9.1977, leg. R. Keskkula, as *R. vulgaris* (Vitt.) M. Lange (S); 1945.- Jämtland, Klövsjö, Skålsjön, appr. 61°39'N appr. 14°21'E, 10.7.1981, leg. R.A. Hintz, as *R. vulgaris* var. *vulgaris* (Vitt.) M. Lange (S); 1946.- Medelpad,Njurunda socken, björkön, sandig tallskog vid havet, 19.9.1977, leg. R. Lidberg, as *R. vulgaris* (Vitt.) M. Lange (S); 1947.- Jämtland, Klövsjö, at the river Ljungan, appr. 14°1'E appr. 62° 39'N, 21.7.1981, leg. R.A. Hintz, as *R. vulgaris* var. *vulgaris* (Vitt.) M. Lange (S); 1948.- Dalarna, Rättvik, Rättviksheden, at the lime works, 30.8.1987, leg. Å. Strid 18272, as *R. vulgaris* (Vitt.) M. Lange (S); 1950.- Hälsingland, Arbrå socken, väster om berget Kipp, sandigmoig barrskogsmark, I katen av dike grävit för ca. 15 år sedan, 27.10.1987, leg. A. Delin, as *R. vulgaris* (Vitt.) M. Lange (S); 1951.- Häsingland, Svabensverk, på gränsen till Dalarna, sjön Amungens sydspets, N om gården Uvbo, Vargåstjärnens västra strans, på öppen jord invid tall, 5.8.1977, leg. J. Nitare, as *R. vulgaris* (Vitt.) M. Lange (S); 1953*.- Norrbotten, Piteå, Alters bruk, 20.9.1887, leg. L.E. Eriksson (UPS); 1954*.- Norrbotten, Ammeberg, 10.1912, leg. E. Fries (UPS); 1955*.- Närke, Laxå bruck på skogsvågar i sandin, 4.9.1882, leg. P.G. Thorin, as *R. rubescens* Tul. ß *amygdalodorus* Th. Fr. (UPS); 1958*.- Dalarne, Malingsbo, 1905, leg. G. Fries (UPS); 1959*.- Skåne, Åhus, Toppet, 8.1889, leg. L.J. Wahlstedt, as *R. provincialis* Tul. (UPS); 1960*.- Bohusland, Morlandad, 4.9.1887, P. Larsson (UPS); 1961*.- Nårke, Aitmorschen, unter Kiefern, 1877, leg. R. Hesse, as *R. provincialis* Tul. (UPS); 1962*.- Bohuslän, Göteborg, Wheda, 18.9.1891, as *R. virens* Tul. (UPS); 1963*.- Nårke, St. Lassåna bruk, 16.9.1887, leg. R. Ljunggnen (UPS); 1975.- Västmanland, Viker, Sjöändan, road side in coniferous forest on limerich soil, 20.8.1988, leg. M. Jeppson (Jeppson 2512); 2028.- Farskinns-Berget, 22.7.1950, leg. L.E. Hawker 140, as *R. vulgaris* (Vitt.) M. Lange (K); 2029.- Odensala, 22.7.1950, leg. M.Lange, ex Herb. Hawker 136, as *R. vulgaris* (Vitt.) M. Lange (K); 2030.- *Idem* 2029 (K); 2142.- Dalarna, Mora köping, by the road of Älvdalen, Saluneb, Alderängarna, on steep, narrow esker, dry heath with *Pinus*, 20.8.1979, leg. I. Kytövuori 79496 (H); 1922.- Suecia 1903, leg. C.G. Lloyd 757, as *R. provincialis* Tul. (S); 1952*.- # Hernösand exerit, 9.1886 (UPS). **UNITED KINGDOM**: 1841.- Scotland, Black Wood of Rannock, forest pattern in pine, 26.8.1954, leg. D.M. Henderson 1604, as *R. luteolus* Fr. (E).

Extralimital collections. CANADA: 1930.- Alberta, Livingston Creek, Kananaskis highway, 25.7.1968, leg. J.P. Bennett 493 (S). SOUTH AFRICA: 1820.- Cape of Good hope, 5.1882, leg. P. Mac Owan, as *Melanogaster owanianus* (Rabenhorst-Winter, Fungi europaei 3436) (UPS). UNITED STATES: 1788.- California, Ingleside district, South of Golden Gate Park, San Francisco, under leaves, beneath eucalyptus and pine trees, 29.10.1904, leg. N.L. Gardner 208, as *R. provincialis* Tul. (California Fungi 558) (UPS, slide BCC-MPM 2025); 1821.- California, San Francisco, Golden Gate Park, 15.3.1923, leg. H.E. Parks 1980, as *R. rubescens* Tul. (California Fungi 559) (UPS, slide BCC-MPM 2027); 2141.- *Idem* (H); 1854.- Oregon, Corvallis, under conifer, 2.12.1926, leg. S.M. Zeller, as *R. vittadinii* (Tul.) Zeller (Fungi of Oregon 7020) (C); 1865.- Carolina del Sud, leg. L. Caldesi, ex Herb. N.A. Pedicino, as *R. rubescens* Tul. (RO); 1872.- Iowa, N.J., on the ground in sandy pine woods, 11.1882, leg. G.N. Copp, as *R. rubescens* Tul. (Ellis-North American Fungi 943) (M); 1965.- *Idem* (UPS); 2006.- *Idem* (G); 2034.- *Idem* (W 991); 1876.- Oregon, Deschutes County, bend, hypogeous in beds of *Pinus ponderosa* and *P.*

contorta seedlings in U.S. Forest Service Nursey, 20.10.1975, leg. R. Molina & J. Trappe 4503, as *R. vulgaris* (Vitt.) M. Lange (M); 1878.- Oregon, Linn. Co., Santiam Pass, hypogeous under *Tsuga mertesiana*, 4820 ft, 24.9.1976, leg. R. molina Ex Herb. Trappe 4724, as *R. vulgaris* (Vitt.) M. Lange (M); 1931.- Ohio, Cincinnati, 5.9.1915, leg. C.G. Lloyd, as *R. rubescens* Tul. (S); 1934.- North-America, leg. C.G. Lloyd 5344, as *R. provincialis* Tul. (S); 1942.- *Idem* (S); 1940.- Florida, on sandy soil in wood of *Pinus*, 23.1.1901, leg. A. Bertolet, ex Herb. Romell, as *R. rubescens* Tul. (S); 2069.- Virginia, Pocohontas Co., Rocky Knob, under needle duff, in *Picea rubens* plantation on reclaimed coal mine, 10.10.1981, leg. S. Miller & G. Bills, as *R. vulgaris* (Vitt.) M. Lange (OULU). URUGUAY: 1941.- Floresta, silv. Pin. & Eucal., alt. 40 m, 1949, ex Herb. Herter 50840, as *R. rubescens* Tul. (Plantae Uruguayenses Exsiccatae 2306) (S); 2001.- Floresta, Dept. Canelones, *Eucalytus*, *Cupressus*, aren. subsicc. , 5.1948, leg. Herter 50134, as *R. roseolus* (Cda.) Hollós (Plantae Uruguayenses exsiccatae 1575e) (G 11412); 2002.- *Idem* 2001 (Planta Uruguayenses exsiccatae 1575 g) (G 11413).

Unknown locality. 1825.- Without any data, as *R. rubescens* Tul. (STR); 1835.- ? Lejectka, S. Carolina, in sylvis inter folia ex Herb. Levier, as *R. rubescens* Tul. (FI); 1867.- Without data, leg. O. Mattirolo, as *Hysteromyces vulgaris* Vitt. (RO); 1893.- Illegible loc. 24.10.1909, as *R. rubescens* Tul. (HBG); 1894.- Without loc., Nadelwäldern, as *R. rubescens* Tul. (HBG); 1899.- Without loc., in pinetis mox hypogaeus mox vertice emergus ab Augusto in autumnum usque, as *R. luteolus* Fr. (Rabenhorst, Herb. mycologicum Ed. II 320) (HBG); 1901.- *Idem* (HBG); 1908.- *Idem* (S); 1994.- *Idem* (BP 22313); 2014.- *Idem* (G); 1911.- Illegible data, as *R. luteolus* (S); 1913.- Illegible data, leg. et det. Bucholtz (S); 1966.- in silvis inter folia dejecta, as *R. rubescens* Tul, *R. luteolus* Vitt., R. albus Schwein (Ravenel, Fungi Caroliani 75) (UPS); 2007.- *Idem* (G); 2037.- Without data, as *R. virens* Fr.(W); 2050.- ? Palma, ex Herb. Montagne, as *R. rubescens* (PC); 2051.- Without data, ex Herb. Montagne, as *R. rubescens* Tul. (PC); 2052.- Without loc. and date, leg. M. Berkeley, ex Herb. Montagne (PC); 2054.- Without data, ex Herb. Montagne, as *R. luteolus* Fr. (PC); 2080.- Without loc., sous Pin d'Alep, terrain sablonneux calcaire, 7.11.1980, leg. de Vries, as *R. vulgaris* (Vries 1279); 2114.- ? Dans les sapinières du Montardaise, 28.2.1980, as *R. luteolus* Fr. (PC).

B) Collections with spore volume between 22.6 and 37.5 mm^3

European collections.**AUSTRIA**: 1324.- Tirolia, in pinetis, 8.1889, leg. I. Bresadola as *R. rubescens* Tul. (UPS, slide BCC-MPM 2042); 1346.- NO bei Litschau, 9.1887, leg. L. Lehnert 883, ex Herb. Beck (PRC); 1351.- Tirol, Hall, Gnadenwald, 9.1912, leg. Schiffner, as *R. rubescens* Tul. (WU); 1389.- N.Ö Mollramer-Wald, Pinus nigra f. austriaca, 25.5.1991, leg. A. & K. Mader (BCC-MPM 1516); 1395.- Wäldchen am Millstädter See in Kärnten, leg. Niessl, as *R. luteolus* (M 28539); 1398.- *Ibidem*, Wälder des Wolfsbergs, 9.1895, leg. Niessl, as *Hymenangium virens* Klotsch. (M); 1587.- Baden bei Wien, 8.9.1876, leg. H.W. Reichardt, as *R. rubescens* Tul. (W); 1618.- Tirol, Ötzlater Alpen, Sölden, *Picea, Pinus, Larix* forest on slope, 24.8.1969, leg. E. Kankainen (OULU); 1619.- *Idem*, 25.8.1969, leg. E. Kankainen, as *R. rubescens* Tul. (OULU). **BELGIUM**: 1971.- Sapinières des environs d'Anvers, dans la Campine, 9.1882, leg. E. Bommer & M. Rousseau as *R. luteolus* Fr. (Roumeguère, Fungi Gallici Exsiccati 2316) (UPS). **CZECH REPUBLIC**: 1347.- Bohemia centralis, pagus Mnichovice prope urbem Praha, 1914, leg. J. Velenovský, as *R. rubescens* (PRC); 1348.- Bohemia centralis, pagus Hradistka prope oppidulum Nymburk, ad viam publicam Hradistka, Kersko, 5.10.952, leg. Z. Moravec, as *R. rubescens* (PRC); 1571.- Bohemia, Trébotov, in piceto, 5.7.1949, leg. V. Vacek, as *R. provincialis* Tul. (=*R. globotus* Vel.) (PR 619013); 1573.- Brno, Kurim, in colle Cimperk, in terra sub *Pinus sylvestris*, 350 m, 10.7.1943, leg. F. Smarda, as *R. roseolus* var. *foetens* Svrček (PR 618990); 1575.- Uhrice prope Kyjov, in silva mixta (*Pinus sylvestris, Quercus, Carpinus*), 15.9.1949, leg. V. Vacek, as *R. aestivus* (Wulf.) Fr. (PR 618971); 1576.- Mnichovice, Hubacov, sub Carpino, 8.1938, leg. J. Velenovský, TYPE of *R. minor* Vel. (PR 154798); 1577.- Trávcice prope Litoměřice, in pineto, 4.6.1948, leg. V. Tryner, as *R. graveolens* Tul. forma *pomaceus* Vacek (PR 619028); 1578.- Bzenec, les "Dúbrava", in pineto arenoso, 9.1955, leg. F. Smarda, ex

Herb. Svrček 1956, as *R. tenuisporus* var. *intermedius* Svrček (PR 742576); 1579.- Jilové, 5. 1924, leg. J. Velenovský as *R. inodorus* Vel. (PR 148574); 1580.- Zvíkovské, Podhradí, in piceto, 24.10.1954, leg. M. Svrček, as *R. tenuisporus* Vel. (PR 742574); 1593.- Mähren, südl. des unteren Scheibenteiches bei Iglau, im Waldboden halbunterirdisch, 8.1933, leg. Canon (W 15128); 1553.- # Bohemia australis, apud viam kersko-Hradisho, in loco arenoso, 5.10.1952, leg. Z. Moravec, as *R. aestivus* Fr. (BP 22307); 1574.- # Zarosice, Dílce, in silva mixta (*Picea*, *Pinus sylvestris*, *Quercus*), 5.9.1946, leg. V. Vacek as *R. roseolus* var. *sulphureus* (Vel.) Svrček (PR 618984). **DENMARK**: 1380.- Sjælland, Tisvilde Hegn, under *Pinus* [Henning Knudsen's letter - 9.11.1992-:"... this locality is very characteristic with poor sandy soil and conifers, mostly *Picea abies* and *Pinus sylvestris*"], 1.10.1975, leg. P. Rabenborg, as *R. luteolus* Fr. (C); 1382.- *Ibidem*, 3.10.1947, leg. M. Lange, as *R. rubescens* Tul. (C); 1383.- *Ibidem*, 11.10.1947, leg. M. Lange, as *R. rubescens* Tul. (C); 1384.- *Idem* (C); 1381.- Sjælland: Asserbo Plantage, under *Pinus sylvestris*, 14.9.1974, leg. Dissing, as *R. luteolus* Fr. (C); 1452.- Jylland: Rise, bois maritimes, 9.1862, leg. Mpagnaguti, as R. provincialis (S). **ESTONIA**: 1308.- Haapsalu, insula Vormsi, Rumpo, ad terram lapillosam in fruticeto juniperoso, sat raro ad terram in pinetis siccis et in fruticetis juniperis, 7.7.1960, leg. H. Trass & E. Parmasto (Mycotheca Estonica, Fasc II, 1961, 74) (UPS, slide BCC-MP 2039); 1372.- *Idem* (BUCM 66334); 1526.- *Idem* (TUR 27704); 1497.- Saaremaaa, Kuressaare, Mändjala, sandfields close to seashore, under *Pinus sylvestris*, 25.9.1990, leg. M. Jeppson (Jeppson); 1523.- Pärnu rajoon, ca. 40 km S of Pärnu, Kabli, near the semester center Lepanina Puhkekodu of Pärnu KEK, dry heath forest on sandy soil, margin of the old way to Riia, near *Pinus sylvestris*, Grid 6434:346, EUR FK3, 23.9.1990, leg. J. Vauras, as *R. rubescens* (TUR 5246); 1671.- Saaremaa, Harilaid, ad terram arenosam, 28.8.1960 (TAA 1110); 1672.- Harjumaa, Tapurla, in Pineto vaccinioso ad terram arenosam, 12.9.1959, leg. U. Kalamees (TAA); 1673.- Saaremaa, Kihelkonna,ad terram arenosam in Pineto, 7.9.1973, (TAA 113362); 1680.- *Ibidem*, 16.7.1959, leg. E. Parmasto (TAA 8627);1675.- Pärnu, Kabli, ad terram arenosam in Pineto, 15.10.1983, as *R. vulgaris* (TAA 14117); 1676.- Rakvere, ad terram arenosa in pineto vaccinioso, 23.8.1976, M. Parmasto (TAA 52501); 1677.- Pärnu, Pärlselja, ad terram arenosam, in Pineto, 1.10.1982, leg. L. Järva, as *R. vulgaris* (TAA 93718); 1679.- Viljandi, Tipu, ad terram in alneto humido, 28.8.1984, leg. L. Järva (TAA 93777); 1681.- Saaremaa, Järve, ad terram arenosam in Pineto, 29.8.1984, leg. M. Hanso (TAA 93778); 1682.- Hiiumaa, Kalara, ad terram arenosam in Pineto, 7.9.1984, leg. L. Järva, as *R. vulgaris* (TAA 93781); 1683.- Pärnu, Päriselja, ad terram arenosam in Pineto, 1.10.1982, leg. L. Järva, as *R. vulgaris* (TAA 93716); 1684.- Pärnu, Lemme, ad terram arenosam in Pinetum, 30.9.1982, leg. L. Järva (TAA 93711); 1685.- Haapsalu, insula Vormsi, Ralby, ad terram arenosam in Pineto, 2.7.1960, leg. M. Kangur (TAA 12656); 1686.- Järvamaa, Valge Hobuse Mägi, ad terram arenosam in Pineto, 10.9.1982, leg. L. Järva (TAA 93692); 1687.- Haapsalu, insula Vormsi, Rumpo, ad terram arenosam in pineto, 8.7.1960, leg. E. Parmasto (TAA 12646); 1689.- *Idem*, leg. M. Fraso (TAA 12647); 1688.- Haapsalu, insula Vormsi, Hullo, ad terram sub *Pinus*, 8.7.1960, leg. E. Parmasto (TAA 12645); 1690.- Saaremaa, Tehumardi, 24.9.1980, leg. L. Järva, as *R. vulgaris* (TAA 93553). **FINLAND**: 1312.- Tavastia australis, Tammela, 9.1876, leg. H.A. Kullhern, as *Hymenogaster lycoperdineus* Vitt. (UPS); 1326.- *Ibidem*, Sept., leg. H.A. Kullhern, as *Gautieria graveolens* Vitt. (UPS); 1446.- Ostrobottnia borealis, Uleåborg, leg. M. Zidbäch, ISOTYPE of *R. borealis* Karst. (UPS, slides BCC-MPM 2135 and 2136); 1447.- Karelia keretina, Knäsa-guba (Knjäschaguba), 1861, leg. P.A. Karsten as *R. lapponicus* Karst. (UPS, slides BCC-MPM 2132, 2133 and 2134); 1760.- *Ibidem*, leg. P.A. Karsten, TYPE of *R. lapponicus* Karst. (H); 1761.- *Ibidem*, 8.1861 ex Herb. Karsten 3695 (H); 1762.- *Ibidem*, 8.1861, leg. P.A. Karsten, as *R. luteolus* Fr. (H); 1494.- Regio Kuusamoënsis, Korsvasvaara, saandy roadside in coniferous wood (*Pinus*), 23.8.1978, leg. M. Jeppson (Jeppson 1139); 1518.- Regio aboënsis, Korppoo, Lohm, small road near seashore, Grid 27° 6677:203, 11.8.1965, leg. A. Pohjola (TUR 27695); 1519.- Satakunta, Yyteri, dunes, Grid 27°E: 282:20, 1.10.1962, leg. M. Eriksson, as *R. luteolus* (TUR 27695); 1520.- Tavastia australis, Ruovesi commune, Grid 27° 687:34, 24.9.1965, leg. Siljamäki (TUR 27707); 1521.- Lapponia inarensis, Inari commune, the crossroad to Kaamanen, heath forest of *Pinus sylvestris*, Grid 27° 767:50, 17.8.1963, leg. I. Kärenlampi, as *R. rubescens* (TUR 15413); 1522.- *Idem* (TUR 15414); 1524.- Nylandia, Hanko comune, Syndalen, dunes, under *Pinus sylvestris*, Grid 27° 6645:288, 12.9.1964, leg. M. Eriksson, as *R. rubescens* (TUR 27701); 1525.- Regio aboënsis, Masku commune, Karevan kangas, heath forest, Grid 27°E 6724: 232, 9.1964, leg. P. Kallio (TUR 27700); 1527.- Savonia australis, Lappeenranta commune, heath forest, margin of road, partly under grasses and mosses, Grid 27° 677:56, 1989, leg. V. Laurikainen (TUR 99162); 1528.- Regio aboënsis, Kuusamo commune, Juuma, Jyrävänkoski, by path, on forest humus, Grid 27° 7353:609, 4.7.1981, leg. A. Puolasmaa, as *R. rubescens* (TUR 73565); 1529.- Ostrobottnia borealis, Rovaniemi rural commune, Pohtimolampi, by yard path, 7.9.1969, leg. A. Pohjola (TUR 17326); 1530.- Nylandia, Hanko, Stroviken, sandy area, near *Pinus sylvestris*, 18.9.1970, leg. M. Eriksson, as *R. luteolus* (TUR 13722); 1532.- Satakunta, Lohensuon lähteiköt, close to the pumping station, by road in sandy pine heath, Grid 27° 6711:267, 20.7.1990, leg. S. Huhtinen 90/85 (TUR 101304); 1533.- Savonia, Lappeenranta commune, near the limestone processing factory, margin of rather dry heath forest of mainly *Pinus sylvestris*, on sandy soil, chalk dust area, Grid 27° 6769:563, 19.8.1987, leg. J. Vauras 2794, as *R. rubecens* (TUR 95979); 1620.- Ostrobottnia borealis, Oulu, Höyhtyä, shore of Lintulammen, Grid 7211:429, 26.8.1972, leg. L. Saaristo (OULU); 1621.- Ostrobottnia borealis, Kemei, Ajos, along road to the radio lighthouse, Grid 27°E 7287:388, 15.9.1984, leg. M. Kamula (OULU); 1626.- *Idem* (OULU); 1622.- Regio kuusamoënsis, Kuusamo, Liikasenvaara, Jäkälämutka of the Oulankajoen, pine forest on sandy ground, Grid 27°E 7358:617, 140 m, 12.6.1976, leg. T. Ulvinen (OULU); 1623.- Lapponia kemensii, Kolari, Hannukainen, Pakasaivo road crossing, Usko Kumpul's summer cottage, sandy ground under planted shrubs, Grid 27°E 7497:381, 170 m, 11.9.1983, leg. T. Ulvinen (OULU); 1624.- Ostrobottnia borealis, Hailuoto, Marjaniemi, in bag on sandy ground (Drosera, Oxycoccus), grid 27°E 7218:385, 8.8.1965, leg. T. Suomalainen (OULU); 1647.- *Ibidem*, sandy transition zone of pine heath and shore dunes, under a pine tree, Grid 7218. 385, 16.8.1981, leg. E. Ohenoja (OULU); 1633.- *Ibidem*, S of Biological station, sandy plains with scattered young pines behind shore dunes, Grid 27°E 7217:385, 2.8.1977, leg. T. Ulvinen (OULU); 1667.- *Ibidem*, sand dune with *Hieracium umbellatum*, Grid 27°E 7218:385, 17.8.972, leg. P. Koskela (OULU); 1625.- Ostrobottnia borealis, Pudasjärvi, Vengas, S side of Pikku-Pylkönsuon, ditched paludified heath on sandy ground, in sand on bank by draining ditch, Grid 27°E 7260:464, 17.7.1974, leg. T. Ulvinen (OULU); 1627.- Ostrobottnia borealis, Keminmaa, Laurila, NW-end of the ridge Kallinkangas, old sandpit revegetated by mosses, Grid 27°E 7305: 386, 2.9.1972, leg. T. Ulvinen (OULU); 1628.- Lapponia inarensis, Inari, crossroad of Kaamasen, pine heath, Grid 27°E 7672:508, 160 m, 17.8.1963, leg. L. Kaärenlampi, as *R. luteolus* Fr. (OULU); 1629.- Ostrobottnia kajanensis, Suomussalmi, Ammänsaari, near the grounds of the factory of Kiaäntama, dry heathy pine forest beaten by trampling (close to habitation¡), Grid 27°E 720:58, 6.8.1976, leg. E. Ohehoja, as *R. luteolus* Fr. (OULU); 1630.- Ostrobottnia borealis, Ylitornio, church village, W slope of Ainionvaaran, beside the trail descending to the Tolppi railway stop, pine heath, Grid 27°R 7361:350, 85 m, 7.9.1973, leg. E. Ohenoja (OULU); 1631.- Lapponia kemensis, Kolari, Ylläsjokisuu, camping place, short-grass-meadow with scattered pines on sandy soil, several groups of fruitbodies, Grid 27°E 7477:363, 150 m, 9.9.1983, leg. T. Ulvinen (OULU); 1632.- Ostrobottnia borealis, Keminmaa, Laurila, SW slope of the southern section of Kallinkangas, on trail through forest, Grid 27°E 7304:386, 26.9.1972, leg. E. Cheneja (OULU); 1634.- Ostrobottnia borealis, Pudasjärvi, Rytinki, Rytinkikangas, SW side of the road from Rytinki to Poijula, about 1.5 km SE of the former, experimental plot 12b, sandy level floor of dry heathy pine forest frequented by grazing reindeer, grid 27°E 7286:516, 195 m, 6.10.1979, leg. E. Ohenoja (OULU); 1644.- *Ibidem*, 29.8.1985, leg. K. Kynsilehto et al. (OULU); 1635.- Lapponia kemensis, Sodankylä, Yli-kitinen, Laiti, along the knolpujoki river about 2 km of the mouth, pine forest of *Empetrum-Vaccinum myrtillus* type (EMT) grazed by reindeer, Grid 27^{a}E 7557:465, 250 m, 31.7.1960, leg. T. Rintanen & J. Taarna (OULU); 1636.- Tavastia borealis, Äänekoski, Parantala, NW part of Aittoniemi, road margin, *Pinus*, *Betula*, Grid 27°E 6950:424, 21.8.1986, leg. M. Jeppson (OULU); 1637.- Ostrobottnia borealis, Oulu, Lopakkaselkä, Amongst moss on track through prest, Grid 27°E 7219:431, 4.9.1968, leg. T. Ulvinen, as *R. rubescens* Tul. (OULU); 1638.- Regio kuusamoënsis, Kuusamo, along the road to Ampumaara, sandy bank by road, Grid 27°E 7364:3469, 20.7.1989, leg. Petti Salo (OULU); 1639.- Ostrobottnia borealis, Kempele, 3.9.1978, leg. L. Verkkoperä (OULU); 1640.- Ostrobottnia borealis, Haukipudas, Keiska, beside the track through heathy forest to Höyhtyä (Saarelaisen) farm, numerous, Grid 27°E 7233:423, 25.8.1966, leg. T. Ulvinen, as *R. rubescens* Tul. (OULU); 1642.- Nylandia, Helsinki, Kallvikude, pine heath, *Calluna*, *Empetrum*, *Pinus*, *Arctostaphylos uva-ursi*, un stabilized sandy ground, Grid 27°E 6676:397, 29.7.1978, leg. R. Saarenoksa (OULU); 1643.- Ostrobottnia borealis, Oulu, Kuivasjärvi, along the road to Lopakkaselbä some 0.5 km E of its junction with the Alakylä road on track through spruce dominated heath forest, Grid 27°E 72198:4311, 13.9.1969, leg. M. Ohenoja (OULU); 1645.- Lapponia kemensis, Savukoski, Värriö, dug up by marten, Grid 752:61, 10.1979, leg. E. Pulliaisen (OULU); 1646.- Ostrobottnia borealis, Haukipudas, along the road to Suckkoperä, sandy ground beside road, grid 7230:724, 5.9.1965, leg. I. Montin, as *R. rubescens* Tul. (OULU); 1648.- Lapponia kemensis, Kolari, Taapajärvi, E of Alasen farm, along the trail from SE of the main road, Grid 27°E 744:40, 1.8.1970, leg. T. Ulvinen (OULU); 1649.- Regio kuusamoënsis, Posio, Livojärvi, Palokangas, in sand by side of forest road on esker, in group, Grid 27°E 7323:554, 260 m, 23.9.1979, leg. T. Ulvinen (OULU); 1650.- Savonia borealis, surroundings of the town Kuopion, Grid 27°E 697: 53, 1967, leg. L. Hakala, as *R. luteolus* Fr. (OULU); 1651.- Ostrobottnia borealis, Oulu, Hiirosenkangas, exposed heathy ground beside road near the home for the aged people, 29.9.1963, leg. T. Ulvinen, as *R. rubescens* Tul. (OULU); 1652.- Lapponia kemensis, Siikajoki, Tauvo, Kalasatama, in sand on dunes, near pines, Grid 27°E 7191-2:384, 1 m, 15.9.1983, leg. E. Ohenoja (OULU); 1653.- Ostrobottnia borealis, Oulu, Oritkari, Uimaranta, Oritkari bathing beach, side of trail in pine forest on sandy ground (by sea), Grid 7210:426, 10.9.1969, leg. T. Ulvinen (OULU); 1654.- Lapponia kemensis, Pelkosenniem, Suvanto, Alankoski rapids of Kitinen river, on road in pine forest, sandy ground, in group of tens of frbs., Grid 27°E 7455:502, 180 m, 26.8.1982, leg. T. Ulvinen (OULU); 1655.- Lapponia kemensis, Kolari, Pasmajaris, along the trail on the N slope of Kotivaara near the villar school, story trail trough heath forest (OULU); 1656.- Nylandia, Helsinki, Kallvik, pinetum, about 30 m from sea, in sand, Grid 27°E 667:39, 17.9.1950, leg. R. Ruotsalo (OULU); 1657.- Ostrobottnia borealis, Kiimiki, Pitkäako, S of the road to Haara farm some 300 m SE of the new Kuusamo road; grassy lane through mixed conifer forest, Grid 27°E 7227:447, 3.9.1979, leg. N. Fritzén, as *R. luteolus* Fr. (OULU); 1658.- Regio kuusamoënsis, Liikasenvaara, lowe course of brook Sirkkapuro, by side of small road to "Metsämaja" cottage, on sandy ground, Grid 27°E 7363:612, 190 m, 24.8.1978, leg. T. Ulvinen (OULU); 1659.- Ostrobottnia borealis, Hailuoto, Santonen, Huikku, dry heath forest verge of a small road, partly subterranean, Grid 7217:408, 27.8.1978, leg. E. Ryhänen (OULU); 1660.- Ostrobottnia borealis, Rovaniemi rural community, Lahtojärvi, SW of Pohtimolammen, a porting center, lower western bank of heath esber at the northern end of the pond, Grid 27°E 7399:426, 7.9.1969, leg. M. Ohenoja (OULU); 1661.- Ostrobottnia borealis, Muhos, Muhosperä Suokylä, E section of Kattilanpalo, in thin turf on trail at site of timber piles in pine forest of *Cladonia* type(ClT), on sandy ground, Grid 27°E 7183:460, 28.9.1975, leg. M. Ohenoja (OULU); 1662.- Ostrobottnia borealis, Haukipudas, Loukkojärvi, W side of the large grounds of timber piles at Satulakangas, sandy soil saturated with heath turfand charcoal by side of an anciant charcoal pit in stand of young pines, Grid 27°E 7235:451, 62 m, 9.9.2967, leg. M. Ohenoja (OULU); 1663.- *Idem* (OULU); 1664.- Karelia australis, Virolahti, Ravijoki, E shore of the outer section of kinasvükki intel, sandy shore by sea, Grid 27°E 671:53, 3.9.1978, leg. T. Rintanen (OULU); 1665.- Lapponia kemensis, Kokkola, Laajahti (Hiekkanokka), sandy beach (by sea), near a pine tree, Grid 27°E 7083:303, 11.9.1981, leg. R. Stolbacka (OULU); 1666.- Ostrobottnia borealis, Keminmaa, Kallinkangas NE-slope, S of the graveyard, Grid 27°E 7304:387, 4.9.1986, leg. V. Tammilehto (OULU); 1668.- Ostrobottnia borealis, Ylitornio, church village, lower W slope of hill Ainionvaara some 100 m E of the Tolppi railway stop, exposed bank beside trail through pine heath, Grid 27°E 7361:350, 85 m, 6.9.1973, leg. E. Oheneja, as *R. pseudoroseolus* A.H. Smith (OULU); 1669.- Regio kuusamoënsis, Kuusamo, Vasanjängänoja, W of the brook, forest road in dry mixed forest (*Pinus, Picea, Betula*), Grid 27°E 73746:5969, 17.7.1991, leg. E. Ohenoja (OULU); 1670.- Ostrobottnia borealis, Haukipudas, Korvenkylä, Kalimenoja, Myllykosken yläpuolella W-rannalla, joenvarren sekametsälehto, nuotiosijan vieressä, grid 27°E 72209: 4335, 17 m, 8.8.1970, leg. M. Ohenoja (OULU); 1708.- Tavastia australis, Hykkilä, 13.18??, leg. H.A. Kullhem, ex Herb. Karsten 3890, as *Gautieria graveolens* Vitt. (H); 1726.- Nylandia, Porvoo mlk., Skavarböle hiekkametsätie, 7.10.1979, leg. Issakainen (H); 1727.- Regio kuusamoënsis, Oivanki, 1 km W of Rantalahti cross-roads, sandy pine forest, 1 ex in bare sand, Grid 27°E 732:59, UTM PP2, 9.8.1970, leg. T. Ahti 27007 (H); 1728.- Regio kuusamoënsis, Kirkonkylä, 6 km N of the church, Saunalainen, on bare sandy bank of highway ditch, ca. 10-15 ex., Grid 27°E 732:59, UTM PP2, 8.1970, leg. T. Ahti 27006 (H); 1729.- Satakunta, Kokemäkti, Peipohja, 1915, leg. Ljuva Tigerstedt (H); 1730.- Savonia australis, Taipalsaari, Karhunpää, by the trailside in dry *Pinus* woodland, Grid 27°E: 6788:555, UTM NH3, 8.10.1972, leg. O. Vitikainen 7732 (H); 1731.- Regio kuusamoënsis, Oulanka, Ampumavaara, Liikasen tien varrella soralla, 2.9.1976, leg. R. Tuomikoski (H); 1732.- Ostrobottnia borealis, Hailuoto, kyrkbyn, 1953, leg. U. & C. Cadercrenty (H); 1733.- Satakunta, Pori, Kuuminainen. 28.8.1950, leg. H. Schröder (H); 1734.- Nylandia, Pernaja, Pernå, Våtskär, merenrantahietikolla, 29.9.1971, leg. J. Eklund (H); 1735.- Nylandia, Tammisaari, Sandö, hiekkaranta, jossa sammalta ja multaa, 31.7.1977, leg. M. Ajo (H); 1736.- Nylandia, Sibbo, Gumbostrand, 10.1953, leg. M. Ervast, ex Herb. Nyberg (H); 1737.- Tavastia australis, Jaala commune, W of the road to Heinola, E side of the lake Iso Nikjärvi in a potato patch by the lake, Grid 27°E 6773:469, UTM MH3, 100 m, 24.9.1989, leg. M. Koivusaari (H); 1738.- Nylandia, Helsinki, Kallvikudde, Kangas, dyynimännikkö (*Pinus, Calluna, Lathyrys maritimus*), polulla, hienoa ja karkeata hiekkaa, Grid 27°E 6676:397, leg. R. Saarenoksa 49183 (H); 1739.- Tavastia australis, Tammela, Salois, 8.1889, leg. A. Karsten 3701 (H); 1740.- Regio kuusamoënsis, Kuusamo, Oulanka, läh. biologista asemaa, maantienojan pohjassa, 22.8.1978, leg. M. Korhonen & R. Tuomikoski 2204 (H); 1741.- Nylandia, Helsinki, Kallvikudden, Mäntykangas, dyyni, paljaalla hiekalla (*Pinus sylvestris, Calluna vulgaris*), Grid 27°E 6676:397, 6.8.1977, leg. R. Saarenoksa 10977 (H); 1742.- Savonia australis, Taipalsaari, Peltoinen, Pyhälahti, kuiva mäntykangas, st pc, 20.9.1965, leg. O. Vitikainen (H); 1743.- Nylandia, Helsinki, Puotinkylä, Malmin hautausmaalle vievän tien varrella, yhdessä Carex ericetorumin kanssa, 1.9.1946, leg. J. Jalas (H); 1744.- Karelia borealis, Nurmijärvi, Kiljava, mäntykangas, hiekkamaa, Grid 27°E 6713:374, 8.9.1975, leg. P. Askola 202 (H); 1745.- Nylandia, Ekenäs Landskom, Tvärminne, 9.9.1936, leg. N. Malmström (H); 1746.- Karelia australis, Virolahti, Sydänkylä, Manstuolinniemi, hiekkainen merenrantamännikkö, 15.8.1974, leg. T. Rintanen (H); 1747.- Nylandia, Vihti, Haapakylä, Luontola, Lerblandal sandjorg, tallskog med björk vägkant, 10.8.1957, leg. N. Malmström (H); 1748.- Regio aboënsis, Dragsfjärd, Dalsbruk, 19.9.1910, leg. E. Qvanström (H); 1749.- Nylandia, Vihti, Nummela, Luontola, 12.9.1965, leg. R. Fagerstén (H); 1750.- Nylandia, Bromarv, Sandö, sandirg barrskog, 1.7.1937, leg. M. Malmström, as *R. provincialis* Tul. (H); 1751.- Nylandia, Ingå, Fageviken, 21.9.1859, leg. M. Hisinger, as *Sphlanchnomyces virens* (H); 1752.- Nylandia, Borgå socken, Vessö, barrskog, UTM MG1, 25.6.1938, leg. W. Nyberg, *as R. rubescens* Tul. (H); 1753.- Nylandia, Esbo, Träskända gård, på sandgång, 10.10.1943, leg. W. Nyberg, as *R. rubescens* Tul. (H); 1756.- Ostrobottnia borealis, Ad Ulaburgum (=Oulu), 1885, leg. Lidbäck, ex Herb. Karsten 3693, as *R. borealis* Karst., *R. lapponicus* Karst? (H); 1757.- Karelia australis, Virolahti, Eerikkälä, 10.7.1977, leg. T. Rintanen, as *R. luteolus* Fr. (H); 1758.- Nylandia, Kirkkonummi, Veikkola, mäntykangas 6.9.1963, leg. H. Toppari, as *R. luteolus* Fr. (H); 1759.- Satakunta, Kankaanpää, Niinisalo, Pohjankangas, inpra Cladinas in pineto sicco, 3.10.1940, leg. M. Laurila, as *R. luteolus* Fr. (H). **FRANCE**: 1284.- Angers, "Belle Beille", *Pinus*, sol. sableux, 30.11.1975, leg. J. Mornand (BCC-MPM 1723, duplex Mornand 7513 G); 1285.- La Prévierè, sous *Pinus*, 21.9.1987, leg. J. Mornand 8718 G (duplex BCC-MPM 1720); 1286.- Jard-sur-Mer, *Pinus*, dunes sables, 31.10.1980, leg. J. Mornand 8006 G (duplex BCC-MPM 1719); 1287.-

Champigny, *Pinus*, sol. sableux, 4.6.1972, leg. J. Mornand 7204 G (duplex BCC-MPM 1718); 1291.- Corse, Forêt de Valdo-Niello, près du gros pin tombé. sous *Pinus nigra* ssp. *laricio,* dessous d'un rocher granitique, UTM MM98, 1000 m, 11.10.1972, leg. V. Demoulin 4526, as *R. roseolus* var. *intermedia* (LG, slide BCC-MPM 1306); 1292.- Corse, Fôret d'Aitone, vers le départ du sentier vers le col de Salto, a la base d'une souche de *Pinus nigra* ssp. *laricio* et non loin *d'Abies alba*, UTM MM87, 1000 m, 11.10.1972, ex Herb. Demoulin 4519, as *R. roseolus* var. *intermedia* (LG, slide BCC-MPM 1307); 1293.- Corse, Col de Serna, N de la Castagniccia, entre Ponte Leccia et Morasaglia, forêt très dégradée de *Quercus ilex* mêlée de pin maritime, sur schistes, avec *Erica arborea*, *Cistus monspeliensis*, semi-hypogé sous *Quercus ilex* et *Erica arborea*, 4.12.1986, leg. J. Lambinon 86/Co/416, as *R. roseolus* (Corda) Th.M. Fr. var. *intermedius* Svrček (LG, slide BCC-MPM 1308); 1294.- Massif des Maures, a l'E du carrefour de la N 558 et de la D 48, plages d'arènes nues entre *Cistus monspeliensis*, sous *Pinus pinea*, 11.11.1968, ex Herb. Demoulin 3807, as *R. vulgaris* (Vitt.) M. Lange var. *vulgaris* (LG, slide BCC-MPM 1403); 1295.- Landes, dunes au N de Mimisan-Plage, forêt de Sainte-Eulalie, dispersés sous *Pinus maritima* avec *R. luteolus* et une forme de *R. roseolus*, 25.10.1968, leg. V. Demoulin, as *R. vulgaris* (LG, slide BCC-MPM 1405); 1299.- Champigny, pins, feuilles, sol sableaux, YT2, 13.6.1979, leg. Mornand (LG); 1301.- Saint Tropez, Plage des Salins, partie arrière des dunes, plage de mousses et thérophytes (*Lobularia maritima*) avec quelques *Pinus pinea*, 11.11.1968, leg. V. Demoulin 3798 (LG, duplex BCC-MPM 1451); 1302.- Alpes-Maritimes, Col de Valferière, entre Grasse et Castellane, semi-hypogé en pinède de *Pinus sylvestris* sur calcaire, 1169 m, 27.9.1983, ex Herb. Demoulin 6575 (LG, slide BCC-MPM 1435); 1333.- Herimoncourt (UPS, slide BCC-MP 2040); 1350.- Pinete dei dintorni di Nizza maritima, Autumno 1859, leg. Barla, as *R. provincialis* (Erbar. Crittogam. Ital. 350) (WU); 1387.- *Idem* (RO); 1448.- *Idem* (S); 1360.- Eggalière bei Nizza, Pinus halepensis, leg. Trimbach, as *R. luteorubescens* Tul. (Groß 779); 1484.- Gallia, ex Herb. Quélet, as *R. graveolens* Vitt. (S); 1545.- Francia, 7.11.1973, ex Herb. Lodz, as *R. briardi* Boud. (MA-Fungi 2892); 1561.- Nice, 1889, leg. D. Barla, ex Herb. Boudier, as *R. luteolus* Fr. (PC); 1562.- *Ibidem*, 10.1889, leg. Barla, ex Herb. Boudier, as R. provincialis (PC); 1563.- *Ibidem*, 1884, leg. Barla, as *R. rubescens* Tul. (PC); 1724.- *Ibidem*, 9.1989, as *R. provincialis* (PC); 1565.- Gujan, bois sablonneux, octobre, leg. M. Chantelat as *R. rubescens* Tul. (Desmazières, Plantes cryptogames de France 263) (G); 1568.- *Idem* (G); 1585.- *Idem* (W); 1973.- *Idem* (UPS); 1613.- Ambert, plus ou moins enfoncé dans le sol au pied des pins, 20.4.1897, ex Herb. Boudier, as *R. luteolus* (PC); 1614.- Antibes, 3.1906, leg. Poirault, ex Herb. Boudier, as *R. rubescens* (PC); 1725.- *Ibidem*, 14.11.1857 (PC); 1616.- Dordogne, leg. Maingaus, ex Herb. Boudier, as *R. rubescens* (PC); 1791.- Corse, Porticcio, CCAS (S d'Ajaccio), dunes de sable récemment plantées de *Pinus halepensis*, UTM MM83, 2.10.1972, leg. V. Demoulin, as *R. vulgaris* (Vitt.) M. Lange (LG, slide BCC-MPM 1301); 1792.- Corse, dunes côtières de la baie de Calvi, un peu à l'E de la ville, dunes plantée de *Pinus pinaster* et *P. pinea*, zone sèche, UTM NN81, 6.10.1972, leg. V. Demoulin 4477, as *R. vulgaris* (Vitt.) M. Lange (LG, slide BCC-MPM 1302); 1793.- *Idem*, ex Herb. Demoulin 4473, *as R. vulgaris* (Vitt.) M. Lange (LG, duplex BCC-MPM 1303); 1794.- Corse, 1 km au N du bois de Pineto sur la langue de terre entre l'étang de Biguglia et Lamer, maquis avec cistes, assez loin de *Quercus suber* et *Pinus pinaster*, 31.12.1985, leg. Moyersoen 71, as *R. vulgaris* (Vitt.) M. Lange (LG); 1795.- *Idem*, leg. Moyersoen 72 (LG). **GERMANY**: 1304.- Wacholderheide bei Kleinziegenfeld, Kreis Lichtenfels, Halbtroceknransen über Jurakalk, 23.10.1982, MTB 5933, 23.10.1982, leg. H. Engel D.127 (LG, slide BCC-MPM 1304); 1320.- Budenheim, in pinetis, raro, autumno, ex Herb. Barbey-Boissier, ex Herb. Fuckel 1894, as *R. rubescens* Tul. (Fungi rhenani 1251) (UPS, slide BCC-MPM 2041); 1342.- *Idem* (PAV); 1331.- Germany, 20.10.1882, leg. P. Magnus, as *R. rubescens* (UPS, slide BCC-MPM 2029); 1349.- Pommern, Gutsdorf bei Callies, am Rande sandiger Heidewege, 29.8.1912, leg. P. Sydow, as *R. provincialis* Tul. (Sydow, Mycotheca germanica 1062) (WU); 1355.- *Idem* (FI 3334); 1366.- *Idem* (DBN); 1371.- *Idem* (FR); 1374.- *Idem* (BUCM 66338), 1376.- *Idem* 1349 (C); 1407.- *Idem* (M); 1421.- *Idem* (HBG); 1454.- *Idem* (S); 1577.- *Idem* (BP 22302); 1591.- *Idem* (W 1859); 1706.- *Idem*

(CUP 1067); 1722.- *Idem* (JE); 1970.- *Idem* (UPS); 1356.- Homburg, Saar, *Pinus sylvestris*, Buntsandstein, 9.10.1974, leg. G. Groß, as *R. vulgaris* var. *intermedius* Svrček (Groß 573); 1357.- *Ibidem*, 7.9.1968, leg. Groß, as *R. vulgaris* var. *intermedius* Svrček (Groß 215); 1410.- *Idem* (M); 1358.- *Ibidem*, 3. 11.1969, leg. G. Groß, as *R. vulgaris* var. *intermedius* Svrček (Groß 349); 1375.- Brandenburgia, in pinetis ad Sophienstadt prope Ruhlsdorf, m. Oct., leg. H. Sydow, as *R. provincialis* Tul. (Kryptogamae exsiccatae 2509) (C); 1592.- *Idem* (W 5135); 1721.- *Idem* (JE); 1400.- Weg von Almbachklamm übers Gatterl nach Ettersberg, 800-850 m, 12.8.1927, leg. Soehner 1262, as *R. provincialis* Tul. (M); 1401.- Wälder bei München, ende Oktober 1921, leg. Ziegler, as *R. rubescens* Tul. (M); 1402.- Umgebung von Ausburg, Dürrenastleide, 26.9.1968, leg. J. Stangl, as *R. rubescens* Tul. (M); 1403.- Umgebung von Ausburg, Siebentichwald, 17.6.1960, leg. J. Stangl, as *R. rubescens* Tul. (M); 1404.- *Ibidem*, 9.1960, leg. J. Stangl (M); 1405.- *Ibidem*, 5.1961, leg. J. Stangl (M); 1406.- Mittenwalde, Lainbachtal, 8.1989, leg. M. Alleschez, as *R. rubescens* Tul. (M); 1409.- Ettersberg bei Schellenberg, Almbachklamm zum Gatterl, 14.8.1927, leg. Soehner 1258, as *R. provincialis* Tul. (M); 1412.- Wank nei Pardenkirchen ünder *Pinus montana*, 4.7.1953, leg. Schlaferdacker-Hildasheim, ex Herb. Soehner 2369, as *R. rubescens* Tul. (M); 1415.- Dreisen, in pinetis, leg. Lasch, as *R. luteolus* Fr. (M); 1416.- Schwenningen, 21.6.1949, leg. Hass, ex Herb. Soehner 2241, as *R. rubescens* Tul. (M); 1417.- Wartha, kr. Fankestein, Schlesien Langer Grund, 3.7.1923, leg. Sem-Oberl Buchs, ex Herb. Soehner 1176, as *R. rubescens* Tul. (M); 1420.- Bei Kirchdorf, 7.9.1894, as *R. rubescens* (HBG); 1422.- Rügen, unter *Pinus sylvestris*, 8.1889, leg. Sydow, as *R. luteolus* Fr. (S); 1423.- Grunewald, 9.1876, leg. Ruhmer, as *R. luteolus* Fr. (HBG); 1425.- Ahlem, 9.1886, leg. Lindblad, as *R. luteolus* Fr. (S); 1443.- Bayer, Oberpfalz, Jura, Kiefernwald, 2.8.1916, leg. S. Killermann, as *R. luteolus* Fr. (M); 1444.- Bayer, Jura, Laaber, Kiefernwald, 29.8.1909, leg. S. Killermann, as *R. luteolus* (M); 1479.- Falkenberg, Guschwitz, as *R. virens* (Albertini & Schweiniz) (Schroeter, Pilze Schbesiens 1685) (S); 1617.- Marne, leg. Mattirolo, ex Herb. Boudier, as *R. rubescens* Tul. (PC); 1691.- Hirschau, sw. München u. Garching bei *Pinus nigra*, 22.8.1970, leg. A. Einhellinger (M); 1692.- Südbayern, Lkr. Wolfratshausen, Ascholdinger Au 2.8.2970, Pupplinger Au. 4.9.1970, leg. A. Einhellinger (M); 1693.- Großhesselohe bei München, 23.7.1919 ex Herb. Soehner, 1376, as *R. rubescens* Tul. (M); 1694.- Augsburg, 27.9.1979, leg. J. Stangl (M); 1697.- Südbayern, 1.1954, leg. S. Killermann (M); 1698.- Oderin, Weg nach Köthen, Kreis Luckau, dürrer Kiefernwald von Univ. Prof. Dr. E. Ulbrich, Berlin, 14.6.1936, ex Herb. Soehner 1513, as *R. angustisepta* Zeller & Dodge (M); 1699.- Südspessart, Sandiger Kiefernwald östl. vom Remberg beim Bahnhof Kreuzwertheim, 8.11.1944, leg. A. Gemünden, ex Herb. Soehner 2114 (M); 1700.- [Allgáuer Alpen, boundary between Germany and Austria], [pass] Schrofenpass [ca. 15,5 km SSW of of Oberstdorf; 47°16'N, 10°12'E], leg. Ade, TYPE of *Hymenogaster pumilionum* Ade (M); 1715.- Ohrdof, Fichtenwald, 26.8.1921, leg. H. Schwedhelm, as *R. luteolus* (JENA); 1716.- Mecklenburg, hab. Forst von Jesendorf (Krs. Sternberg), unter *Pinus sylvestris* im Sandboden, meistens etwas aus dem Boden ragend, MTB 2135/4, 50 m, 28.9.1987, as *R. vulgaris* (Vitt.) M. Lange (JENA); 1717.- Plane, 7.8.1942, leg. Eberst, as *R. rubescens* Tul. (JE); 1718.- Haina, Bleimühle, Tal nach dem Schießplatz zu. Wegrand, 18.7.1969, leg. Gröger, as *R. rubescens* Tul. (JE); 1719.- Dübener Heide, bei Kemberg, háufig auf Sandwegen im trock, Kiefernforst, 8.1961, leg. Gröger, as *R. rubescens* (JE). **HUNGARY**: 1546.- Ördögtorony pr. Pilisszentiván, Mts. Pilis, 4.6.1965, leg. P. Jakucs, as *R. aestivus* Fr. (BP 43430); 1547.- Prope pag. Fülöpszázallas (9182) in Kiskunság Nat. park in pineto culto (Pinus nigra), 31.5.1978, leg. M. Babos (BP 79685); 1548.- *Ibidem*, 8.11.1982, leg. M. Babos & L. Albert (BP 79686); 1550.- *Ibidem*, 6.5.1978, leg. M. Babos & A. Friesz (BP 79687); 1549.- Nyáregyháza "Pótharasztpuszta" (8782), comit. Pest in pineto culto, 24.10.1976, leg. E. Murai (BP 79689); 1552.- Mts. Budai, 4.8.1969, leg. Nagy L., as *R. rubescens* Tul. (BP 55873); 1554.- Nagykopasz-hegy, Com. Pest, sub *Quercus*, 27.5.1956, leg. P. Makara, as *R. aestivus* Fr. (BP 26905); 1555.- Mts. Budai, Csiki-hegyek, Sorrento, 1.6.1975, leg. I. Farkas, as *R. aestivus* Fr. (BP 51756); 1556.- Mts. Budai, Hársbokor-hegy, in silva mixta, 29.7.1957, leg. G. Bohus & M. Babos, as *R. aestivus* Fr. (BP 39894). **ITALY**: 1343.- Veralta, supra San Mauzo di Saline (Verona), sulla terra muscosa sotto alle conifere (*Pinus sylvestris*), 800 m, 16.9.1889, leg. C. Massalongo, as *R. rubescens* Tul. (VER); 1344.- Sopra la contrada Righetti presso Bolca (Verona), sulla terra muscosa in un bosco de Castagni (*Castanea sativa*) e *Pinus sylvestris*, 900 m, 10.1887, leg. C. Massalongo, as *R. rubescens* Tul. (VER), 1353.- Selva Pisana, sui Tomboli, 9.10.1862, leg. O. Beccari, as *R. provincialis* Tul. (FI 3334); 1408.- *Idem* (M); 1453.- *Idem* (S); 1583.- *Idem* (W 8443); 1397.- In Trockenem Föhren wäldchen bei Castelfondo, Tirol, "Panetei", leg. Heuffer, as *R. rubescens* (M); 1414.- Bozen, Tirol, as *R. luteolus* Fr. (M); 1466.- Monti di Verla, 5.1899, leg. Marchi, as *R. rubescens* Tul (S); 1467.- Specchia, sub. *Pinus sylvestris*, leg. G. Bresadola, as *R. rubescens* Tul. (S); 1469.- Val di Noto, ad terran sub *Pinus sylvestris*, 7.1896, leg. L. Selmi, as *R. rubescens* Tul. (S); 1473.- Mendola, subterra in silva *Pinus*, 1904, as *R. rubescens* Tul. (S); 1476.- Monti Calvaniae, in terra, 16.9.1887, leg. A. Kmet, as *R. niveus* (S); 1695.- Appianum, 9.1924, ex Herb. Bresadola 1808, as *R. virens* Alb. & Schw. (M); 1705.- Tombolo, Livorno, *Pinus pinaster*, 5 m, 5.4.1984, leg. A. Montecchi 895 (duplex BCC-MPM 1526); 1713.- Sardegna, Budoni (NO), bosco di Pino sito in prossimità del mare, su una duna di sabbia, semi-hipogeo, 28.10.1990, leg. G. Ricci (BCC-MP 1784); 2364.- Sardegna, Oristano, Torre Grande, in terreno sabbioso tra Eucaliptus e pini, zona mediterranea in autumno, 27.11.1981, leg. Pacioni , HOLOTYPE of *R. sardous* Pacioni (AQUI, slide BCC-MPM 2212); 2531.- Baia Sardiniia (SS), Sargena, pineta in rive al mare, 3.11.1984, leg. M. Sarasini, as *R. vulgaris* v. *intermedius* Svrček (Sarasini 146); 2532.- S. Giacono (SO), boschetto, sotto *Pinus mugo*, 2100 m, 10.8.1987, leg. S. Aiana, as *R. vulgaris* v. *intermedius* Svrček (Sarasini 267); 2535.- Ferrara (RC), bosco fino laricio, 7.11.1988, leg. M. Valoti, as *R. vulgaris* v. *intermedius* Svrček (Sarasini 316); 2536.- Lido di Volano (FE), pini marittimi e lecci, 8.4.1989, leg. M. Sarasini, as *R. vu*lgaris var. *intermedius* Svrček (Sarasini 329); 2538.- Marina di Vecchiano, litorale marino, macchia mediterranea con pini, 28.4.1990, leg. A. Bincoletto & M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 382); 2543.- *Ibidem* 2538, *Pinus pinaster*, 2.10.1992, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 451); 2540.- Budoni (MU), pineta de Budoni, pineta sabbiosa con pini marittimi in riva al mare, 27.10.1990, leg. G. Pirola, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 401); 2542.- Calambrone (PL), Toscana, Riserva dell'olivo, bosco retroduna con pini e lecci, 2.4.1992, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 442). **Letonia**: 1413.- Auf Heideviesen bei Talsi, 8.1886, leg. Alleschez, as *R. rubescens* Tul. (M). **Lithuania**: 1696.- Varena, in silvis, 1921, leg. G. Bresadola 1809, as *R. virens* (Alb. & Schw.) Fr. (M). **Norway**: 1310.- Sör-Tröndelag, Brekken near Feragen, in gravel, 16.7.1975, leg. N. Lundquist (UPS); 1367.- Hedmark, Tynset, Savalen fj. stue, torr furumo, NQ 70, 26.7.1970, leg. O. Gjærevoll (TRH); 1538.- Rogaland, Klepp, 9.1981, leg. R. Hanhelad (BG). **Poland**: 1379.- Breslau, Silesiae, 10.1872, leg. L. Becker, as Hymenangium virens Klotzch (C). **Portugal**: 1272.- Minho, Parque Nacional de Peneda-Gerès, Terras de Bouro, Gerès, Malhadoura, bajo *Pinus sylvestris*, UTM 29T NG7418, 650 m, 28.4.1989, leg. M. Dunàbeitia (BCC-MPM 1082); 1298.- Algarve, au N de la r. de Sagres au Cabo de S. Vicente, près de *Pinus pinaster* sur sable, 27.12.1971, leg. V. Demoulin 4208, as *R. vulgaris* (Vitt.) M. Lange (LG, slide BCC-MPM 1412); 1341.- Soalheira, S. Fiel e arredores, nos pinhaes, 9.1902, leg. J. da Silva Tavares 1536 F as *Rhizopogon rubescens* Tul. (Flora Lusitanica exsiccata 1716) (PO); 1362.- *Idem* (LISU); 1377.- *Idem* (C); 1584.- *Idem* (W); 1359.- Estremadura, Almada, Fonte da Telha, Pinhal do Rei, 12.1982, leg. M. Correia PL2483 (LISU); 1361.- Estremadura, Óbidos, Lagoa de Óbidos, 4.1981, leg. I. Melo et al. PL 2462 (LISU); 1449.- S. Fiel, in pinetis, 12.1903, leg. Torrens, as *R. provincialis* Tul. (UPS); 1511.- Madeira, Queimadas, hypogeous under *Pinus* sp., 880 m, 18.1.1977, leg. R.P. Korf et al., as *Rhizopogon rubesces* (Tul.) Tul. (Mycoflora of Macaronesia 1609) (CUP); 1512.- *Idem* (Mycoflora of Macaronesia 1608) (CUP); 1517.- *Idem* (Mycoflora of Macaronesia 1610) (CUP); 1513.- Madeira, between Terreiro da Luta and Poiso, dirt rd. cut-off at km mark 7.4, hypogeous under *Pinus* sp., 16.1.1977, leg. R.P. Korf et al., as *R. rubescens* (Tul.) Tul. (Mycoflora of Macaronesia 1570) (CUP); 1514.- Madeira, toward Encumeda, 1 km above Vinháticos, hypogeous in young *Pinus* sp. stand, 15.1.1977, leg. R.P. Korf et al., as *R. rubescens* (Tul.) Tul. (Mycoflora of

Macaronesia 1544) (CUP); 1515.- Madeira, valley just east of Jardim da Serra, lying on top of ground unattached in *Pinus* sp. stand, 14.1.1977, leg. R.P. Korf et al., as *R. rubescens* (Tul.) Tul. (Mycoflora of Macaronesia 1518) (CUP); 1516.- Madeira, toward Monte, km mark 10.5 from Funchal, at burn site along road below Poiso, emergent in *Pinus* sp. stand, 13.1.1977, leg. R.P. Korf et al., as *R. rubescens* (Tul.) Tul. (Mycoflora of Macaronesia 1514) (CUP); 2495.- Estuario de Sado, 13.11.1991, leg. F.D. Calonge (BCC-MPM 1979); 2498.- # Azeditero, 11.11.1991, leg. F.D. Calonge (BCC-MPM 1982). **Rusia**: 1674.- Carelia, Kalevala, ad terram, *Pinetum vacciniosum*, 7.8.1965 m leg. E. Parmasto 13483 (TAA); 1678.- *Ibidem*, 8.8.1965, leg. E. Parmasto (TAA 18113). **Spain**: 1252.- Girona, Sant Pere del Bosc, Lloret de Mar (La Selva), 14.10.1991, leg. D. Sierra (BCC-MPM 1479); 1253.- Girona, zona de Montgrí (Baix Empordà), 27.10.1991, leg. I. Borrás (BCC-MPM 1472); 1254.- Barcelona, Santa Coloma de Cervellò (Baix Llobregat), UTM DF18, 173 m, bosque mixto, 18.11.1984, leg. M.P.M. (BCC-MPM 106); 1255.- Barcelona, Pantà de Foix, Foix (Garraf), pinar, UTM CF86, 100-200 m, 7.6.1984, leg. X. Llimona (BCC-MPM 334); 1256.- Barcelona, Begues (Baix Llobregat), UTM DF07, 350 m, bajo *Pinus halepensis*, 24.11.1985, leg. A. Canals (BCC-MPM 555); 1257.- Barcelona, Collcerola, 24.11.1985, leg. J. Cambra (BCC-MPM 558); 1258.- Girona, Gatosa d'en Riusec, Llagostera (La Selva), alcornocal (*Quercus suber*), 2.12.1992, leg. D. Sierra, A. Sánchez & M.P.M (BCC-MPM 1592); 1259.- *Idem* (BCC-MPM 1594); 1260.- *Idem* (BCC-MPM 1595); 1265.- *Idem* (BCC-MPM 1590); 1261.- Barcelona, Sobirans (Maresme), talus amb *Quercus suber* i *Erica arborea*, 18.2.1993, leg. A. Sánchez (BCC-MPM 1611); 1262.- Jaén, leg. Felipe Jimenez (BCC-MPM 1489); 1263.- Cádiz, leg. Carmen Fajardo & J.R. Sogorb (BCC-MPM 1490); 1264.- Girona, Mas Pericay (Gironès), bajo *Quercus suber*, *Arbutus unedo*, *Erica scoparia*, 26.5.1993, leg. M.P.M. (BCC-MPM 1656); 1266.- Mallorca, Escorca, Predio Majanor, en lugar despejado en un bosque de *Pinus halepensis* con algún *Pinus pinea* y no lejos de *Cistus monspeliensis*, 700-800 m, 8.10.1991, leg. J.L. Siquier 113 G (duplex BCC-MPM 1508); 1267.- Girona, Gatosa d'en Riusec, carretera hacia Sant Grau (Baix Empordà), Km 5.5, camino de un pinar bajo *Smilax* y *Rubus*, 20.10.1988, leg. M.P.M. (BCC-MPM 1058); 1268.- *Idem* (BCC-MPM 1060); 1269.- Barcelona, cap Olzinelles (Vallès oriental), bajo *Pinus pinea*, 20.3.1993, leg. A. Sánchez; 1270.- Girona, pasado Santa Pellaia, dirección Sant Sadurní de l'Heura, bajo *Pinus pinaster*, 26.5.1993, leg. A. Sánchez (BCC-MPM 1657); 1271.- Barcelona, Badalona, pinar, 13.12.1987, leg. A. Villagrosa (BCC-MPM 886); 1273.- *Ibidem*, *Pinus pinea* forest on acid sandy soil, 14.12.1985, leg. M. Tabarés, A. Rocabruna & M. Jeppson (BCC-MPM 1682); 1274.- Barcelona, Orrius (Maresme), dry mediterranean vegetation with *Pinus pinea*, *Quercus ilex*, *Cistus* sp. on siliceous soil, 14.12.1985, leg. M. Tabarés, A. Rocabruna & M. Jeppson (BCC-MPM 1683); 1275.- *Ibidem*, roadside under *Pinus pinea*, 14.12.1985, leg. M. Tabarés, A. Rocabruna & M. Jeppson (BCC-MPM 1684); 1276.- Lleida, La Masella (Cerdanya), bajo *Pinus sylvestris*, 3.6.1989, leg. A. Rocabruna (BCC-MPM 1094); 1277.- Tarragona, Punta de la Mora, pinar y sabinar (Tarragonès), 15.10.1989, leg. N. Pamies (BCC-MPM 1129); 1278.- Jaén, Camino de Nava de San Pedro, Cazorla, bosque de *Pinus nigra*, *P. pinaster* y *Quercus ilex*, 11.5.1990, leg. S. Santamaría (BCC-MPM 1237); 1279.- Valladolid, Tudela de Duero, 7.4.1989, leg. J.C. Santos (BCC-MPM 1694); 1280.- Madrid, Valle del Paular, junto al Monumento al Guarda Forestal, 6.11.1988, leg. M. Oltra (BCC-MPM 1699); 1281.- Mallorca, Marjanó, Escorca, 17.2.1988, leg. J.L. Siquier (BCC-MPM 1704); 1282.- Teruel, Orihuela, 23.10.1991, leg. F.D. Calonge (BCC-MPM 1709); 1283.- León, Destriana, pinar, 880 m, 6.12.1990 (BCC-MPM 1712); 1288.- Mallorca, leg. J.L. Siquier 81 G (duplex BCC-MPM 1711); 1296.- Jaén, leg. Felipe Jiménez (BCC-MPM 1489); 1297.- Cádiz, Algeciras, leg. Mª Carmen Fajardo (BCC-MPM 1490); 1300.- Gran Canaria, alrededores de la Cruz de Tejeda, hacia el Pozo de las Nieves, pequeño pinar artificial repoblado de *Pinus insignis* (acompañado de una formación *Micromerio-Cytisetum congesti*, 1.12.1972, leg. W. Wildpret, Acebes y E. Beltrán, ex Herb. TFC (LG, duplex BCC-MPM 1456); 1303.- Málaga, au S d'Alhausin El Grande, près du carrefour de la r. Mijas-Coin, surtout en plage rocailleuse, garrigue (*Rosmarinus*, *Erica*), entre les pins, 1.1.1972, leg. V. Demoulin 4228 (LG, duplex BCC-MPM 1432); 1306.- Valladolid, Tordesillas, dans la vallée du

Duero au bord de la r. de Salamanca, pelouse sur sable à prox. de *Pinus pinea*, 22.12.1971, leg. V. Demoulin 4195 (LG, duplex BCC-MPM 1436); 1307.- Mallorca, presqu'ille d'Alcudia, descente du Col Baix ver la crique de la côte Est, forêt de *Pinus halepensis* sur calcaire, 20.5.1977 (LG, slide BCC-MPM 1439); 1322.- Tenerife, 9 Km SW of la Esperanza near Mt. Gaitero at highroad, in sand under *Pinus canariensis*, 19.4.1974, leg. S. Ryman (UPS); 1328.- Tenerife, Montaña Ayosa, ca. 9 Km SW of La Esperanza, at highbroad 824, ca. 1760 m, 19.4.1974, leg. R. Nannfeldt (UPS); 1336.- Tenerife, Mt. Teide, S part of Las Cañadas, El Sombrero, in soil under *Pinus canariensis*, 26.1.1977, leg. N. Lundquist (UPS); 1339.- Tenerife, Orotava valley, upper part between Aquamansa and El Portillo, 1600 m, in rocky ground in a thin *Pinus canariensis* forest, 7.1.1968, leg. R. Santesson 19446 (UPS); 1368.- Málaga, pinar, otoño 1991, leg. Javier Gómez (BCC-MPM 1492); 1369.- Jaén, exposición micológica de Linares, otoño 1991, (BCC-MPM 1494); 1370.- *Idem* (BCC-MPM 1493); 1373.- Tarragona, Tora dels Pins del Canalot, Punta de la Banya, delta de l'Ebre, (Baiz Ebre), 15.3.1992, leg. A. Curcó (BCC-MPM 1498); 1391.- León, Montearenas, 29TQH01, *Pinus sylvestris*, 12.11.1989, leg. B. Llamas & M.K. Dunabeitía LE11 (BCC-MPM 1531); 1392.- León, Lillo de Bierzo, pinar talado, 11.11.1989, leg. B. Llamas & M.K. Dunabeitía LE 14 (BCC-MPM 1532); 1393.- León, La Butarga, 29TPH83, *Pinus sylvestris*, 12.11.1989, leg. B. Llamas & M.K. Dunabeitía LE 13 (BCC-MPM 1528); 1394.- León, Taranilla, *Pinus sylvestris*, 16.12.1991, leg. J.L. Dunabeitía & M.C. Aurrekoetxea LE 20 (BCC-MPM 1529); 1396.- Pirineo de Huesca, 30.5.1990, leg. J.M., ex Herb. Dunabeitía HU1 (BCC-MPM 1535); 1503.- Tenerife, 0.9 km west of intersection to Las Raices, hypogeous under *Pinus canariensis*, 1150 m, 29.12.1976, leg. R.P. Korf et al., as *R. vulgaris* (Vitt.) M. Lange sensu Smith in Smith & Zeller (Mycoflora of Macaronesia 1239) (CUP); 1504.- *Idem* (Mycoflora of Macaronesia 1240) (CUP), 1505.- *Idem* (Mycoflora of Macaronesia 1250) (CUP); 1506.- Hierro, Taibique, 6.5 km from junction of roads s.w. of San Andrés, hypogeous to emergent under Pinus sp., 7.1.1977, leg. R.P. Korf et al., as *R. vulgaris* (Vitt.) M. Lange sensu Smith in Smith & Zeller (Mycoflora of Macaronesia 1431) (CUP); 1507.- *Idem* (Mycoflora of Macaronesia 1435) (CUP); 1508.- Hierro, 4.5 km toward Taibique fro intersection of roads S.W. San Andrés, north edge of pine forest, emergent under *Pinus* sp., 7.1.1977, leg. R.P. Korf et al., as *R. vulgaris* (Vitt.) M. Lange sensu Smith in Smith & Zeller (Mycoflora of Macaronesia 1436) (CUP); 1509.- Tenerife, Woods along road of Bosque de la Esperanza at Km mark 12, hypogeous under *Pinus canariensis*, 29.12.1976, leg. R.P. Korf et al., as *R. vulgaris* (Vitt.) M. Lange sensu Smith in Smith & Zeller (Mycoflora of Macaronesia 1248) (CUP); 1510.- *Idem* (Mycoflora of Macaronesia 1249) (CUP); 1534.- Girona, S'Arenella (Alt Empordà), pineda, 15.11.1992, leg. X. Llimona (BCC-MPM 1604); 1535.- Girona, Vidreres, Urbanización La Goba (La Selva), in pine forest on sandy soil, 30.10.1992, leg. F. Bueno & M.P.M. (BCC-MP 1570); 1536.- *Idem* (BCC-MPM 1572); 1537.- *Idem* (BCC-MPM 1575); 1539.- Almería, Bayarque, en pinar de *Pinus halepensis*, 2.11.1986, leg. J.A. Orla de Rueda (MA-Fungi 16528); 1540.- Ávila, Barco de Ávila, 5.10.1986, leg. F.D. Calonge (MA-Fungi 16415); 1541.- Ávila, Peguerinos, 12.10.1986, leg. F.D. Calonge (MA-Fungi 16434); 1542.- Segovia, entre Coca y Nava de la Asunción, semienterrado bajo *Pinus pinaster*, 12.4.1974, leg. J. Hernando, as *R. vulgaris* (Vitt.) M. Lange (MA-Fungi 4103); 1543.- Guadalajara, Sigüenza, en pinar, 26.5.1981, leg. F.D. Calonge, as *R. luteolus* Fr. (MA-Fungi 4893); 1544.- Ávila, Santa Maria de la Alameda, 25.10.1974, leg. Fajardo (MA-Fungi 3919); 1581.- Gran Canaria, Pinar de Tamadaba, terrícola, muy común sobre todo a principios de otoño, 20.11.1978, leg. A. Bañares, as *R. vulgaris* (Vitt.) M. Lange (TFC Mic 1330); 1594.- Murcia, Sierra Espuña, 14.4.1978, leg. G. Malençon ex Herb. Honrubia 1008, as *R. vulgaris* (MUB 1785); 1595.- Murcia, Sierra Carrascoy, *Pinus halepensis* & *P. pinea*, 21.4.1978, leg. G. Malençon ex Herb. Honrubia 1316, as *R. vulgaris* (MUB 1784); 1596.- Albacete, Mesones, *Pinus pinaster*, 18.4.1978, leg. G. Malençon, ex Herb. Honrubia 1167, as *R. vulgaris* (Vitt.) M. Lange (MUB 1783); 1597.- Albacete, Paraje Villa Estrella, Viliarrobledo, pinar de *Pinus halepensis*, WJ35, 5.11.1979, leg. S. Garcia, ex Herb. Honrubia 2553, as *R. rubescens* Tul. (MUB 1776); 1598.- Albacete, Sierra de Alcaraz, Riopar, Campamento S. Juan, pinar de *Pinus pinaster* & *P. clusiana*, 1040 m, WH

4959, 17.10.1979, leg. M. Honrubia 2162, as *R. rubescens* Tul. (MUB 1775); 1599.- Albacete, Almansa, pantano de Almansa, pinares de repoblación de *Pinus halepensis*, 740 m, XJ 5804, 12.10.1979, leg. M. Honrubia 2062, as *R. rubescens* Tul. (MUB 1772); 1600.- Jaén, Sierra de Segura, pinar de *Pinus pinaster*, WG08, 26.10.1979, leg. M. Honrubia & J.M. Egea 2353, as *R. rubescens* Tul. (MUB 1774); 1601.- Albacete, Mesones, Sierra del Calar del Mundo, en pinar de *Pinus pinaster*, suelo arenoso, junto arroyo, 950 m, WH 5659, 7.4.1979, leg. M. Honrubia 1786, as *R. rubescens* Tul. (MUB 1770); 1602.- *Ibidem*, 18.11.1978, leg. M. Honrubia 687 (MUB 1767); 1611.- *Ibidem*, 20.4.1978, leg. G. Malençon, ex Herb. Honrubia 1298, as *R. vulgaris* (Vitt.) M. Lange (MUB 1782); 1603.- Huelva, Sierra de Aracena, enterrado en suelo en un alcornocal, 15.11.1987, leg. A.Gª. Buendía (GDAC 21720); 1604.- Granada, La Pera, pinar, 993 m, UTM 30 SVG72, 7.12.1985, leg. A. Ortega & A.Gª. Buendía (GDAC 24676); 1605.- Málaga, pinsapar (*Abies pinsapo*), 21.11.1984, leg. A. Ortega (GDAC 21827); 1606.- Granada, Alfaguara, El Jardín, Parque Natural de la Sierra de Huétar, 1219 m, UTM 30SVG52, pinar, 23.11.1984, leg. A.Gª Buendía (GDAC 21825); 1608.- *Ibidem* 1606, cerca de la casa forestal, pinar, bajo pinos, 17.10.1977, leg. G. Malençon et al. (Mycotheca Hispanica) (GDAC 10593); 1607.- Granada, Monachil, "Los Cachorros", pinar, 27.10.1979, leg. D.M. Isac & R. Galán (Mycotheca Hispanica 420) (GDAC 11262); 1609.- Cuenca, Valle del río Toba, pinares, 18.11.1977, leg. A. Ortega et al., as *R. rubescens* (GDAC 10595); 1610.- Jaén, Sierra Segura, pinar, 29.10.1986, leg. A. Ortega & A.Gª. Buendía (GDAC 24677); 1612.- Granada, Los Guajares, pinares, 15.11.1978, leg. A.T. Romero & P. Sanchez (Micoteca Hispanica 10594) (GDAC 10594); 1701.- Córdoba, bajo *Pinus*, en grupos numerosos de hasta 120 ejemplares, suelo ácido, 5.1993, leg. B. Moreno (BCC-MPM 1675); 1702.- Girona, Lloret de Mar, Sant Pere del Bosc (La Selva), *Pinus halepensis*, *Quercus ilex*, *Erica*, *Arbutus*, algún *Quercus suber*, 7.11.1993, leg. M.P.M. (BCC-MPM 1729); 1703.- Cádiz, bajo pinos y brezos, 10.1992, leg. B. Moreno (BCC-MPM 1672); 1704.- Córdoba, bajo acebuche (*Olea europaea* var. *sylvestris*), suelo posiblemente ácido, 1992, leg. B. Moreno (BCC-MPM 1681); 1709.- Teruel, Beseit, *Pinus sylvestris*, 1.9.1987, leg. C. Calvet (MA-Fungi 28340); 1710.- *Ibidem*, 26.8.1989, leg. J. Pera & X. Parladé (MA-Fungi 28341); 1711.- La Coruña, El Ferrol, *Pinus sylvestris*, 12.11.1989, leg. M. Duñabeitia & R. Llamas (MA-Fungi 28342); 1712.- Asturias, Pruneda, Cabranes, *Pinus radiata*, 350 m, 12.5.1986, leg. R. Molina, as *R. vulgaris* (Vitt.) M. Lange (MA-Fungi 28353); 1714.- Ibiza, San Carles de Balanzat, hábitat tipo Ibiza, 100 m, 13.11.1993, leg. J.L. Siquier I-4G (duplex BCC-MPM 1787); 1868.- Ibiza, Es Buscatell, Puig d'En Francolí, hábitat tipo Ibiza, 200 m, 13.11.1993, leg. J.L. Siquier I-3G (BCC-MPM 1786); 2319.- Girona, Santa Pellaia (Baix Empordà), b/ *Pinus pinaster*, 25.5.1994, leg. M.P.M. (BCC-MPM 1861); 2380.- Lugo, Orbazary, talud, 29TPH1462, 2.12.1979, leg. M. Castro (LOU-Fungi 584); 2381.- La Coruña, Santiago, Selva Negra, talud, base de pinar, 28.11.1976, leg. L. Freire (Castro 600); 2382.- Pontevedra, Barra, suelo de pinar dunar, 19.11.1988, leg. J. Moldes (Castro 3650); 2383.- Pontevedra, Cangas, Barra, suelo pinar dunar, 4.1.1987, leg. J. Moldes & F. Fernández (Castro 587); 2384.- *Ibidem*, 20.1.1987, leg. J. Moldes & F. Fernández (LOU-Fungi 590); 2385.- *Ibidem*, suelo pinar *Pinus pinaster* y *P. pinea* 29.3.1987, leg. M. Castro, L. Freire & G. Martínez (LOU-Fungi 595); 2386.- La Coruña, Santiago, Pedroso, talud, bajo pinos, 18.12.1979, leg. L. Freire & M. Castro (LOU-Fungi 592); 2387.- Pontevedra, Cangas, playa de Barra, suelo pinar de *Pinus pinaster* y *P. pinea,* 29.3.1987, leg. M. Castro, L. Freire & C.G. Marín (LOU-Fungi 596); 2432.- La Coruña, Pobra do Caramiñal, Cabio, 29TNH0516, b/ *Pinus pinaster* en suelo dunar (pH 8), 6.2.1992, leg. J. Blanco (BCC-MPM 1869); 2442.- Girona, Begur, dunas (Baix Empordà), 16.11.1993, leg. C. Gutierrez (BCC-MPM 1736); 2490.- Teruel, Orihuela, b/ *Pinus sylvestris*, 23.10.1991, leg. F.D. Calonge (BCC-MPM 1974); 2493.- Vigo, campus universidad, b/ coníferas cultivadas, 29.10.1991, leg. A. García Morales (BCC-MPM 1977); 2496.- Teruel, Tramacastilla, UTM 30T XK2181, b/ *Cistus laurifolius*, 5.12.1993 (BCC-MPM 1980); 2497.- *Idem* (BCC-MPM 1981); 2502.- Girona, Mas Florit (Baix Empordà), bosque de *Quercus suber* con *Rubus*, *Asparagus*, 20.11.1993, leg. M. Aguasca (BCC-MPM 1766); 2504.- Girona, Fitor (Baix Empordà), 18.11.1993, leg. M.A. Perez de Gregorio (BCC-MPM 1764); 2506.- Girona, Dunas

de Pals (Baix Empordà), *Pinus pinea*, 19.11.1993, leg. Girbal & M. Aguasca (BCC-MPM 1745); 2507.- *Ibidem*, 19.11.1993, leg. Palazón et al. (BCC-MPM 1744); 2508.- *Idem* (BCC-MPM 1742); 2509.- *Idem* (BCC-MPM 1741); 2510.- *Idem* (BCC-MPM 1740); 2512.- *Idem* (BCC-MPM 1739); 2514.- Girona, Torroella de Montgrí, Platja de Pals (Baix Empordà), bosco sabbioso di *Pinus pinea* pulito, 16.11.1993 (Sarasini 533); 2515.- Girona, La Bisbal, Riera Vilà (Baix Empordà), boschi di lecci e pini, 150 m, 17.11.1993, leg. A. Galbusera (Sarasini 538), 2546.- Barcelona, Sant Celoni (Vallès Oriental), Montnegre, macchia con lecci, *Arbutus* e pini, 26.10.1993, leg. M. Sarasini (Sarasini 516); 2547.- Girona, Parco Sant Grau (La Selva), *Pinus pinaster*, *P. radiata* e lecci, 27.10.1993, leg. F. Bersan & M. Sarasini (Sarasini 521). **SWEDEN**: 1309.- Västerbotten, Umeå, på sand i granskog, 21.8.1903, leg. J. Vleugel & L. Romell, as *R. rubescens* (UPS); 1311*.- Uppland, Eklundohof, leg. Th. Fries (UPS, slide BCC-MPM 2043); 1313.- Uppland, Dalarö, 13.10.1892, leg. G. Thollander (UPS); 1314.- Uppland, Bergsbrunna, 25.8.1883, leg. H. Juhlin-Dannfelt (UPS); 1315.- Södermanland, Stockholm, Enskede, 4.9.1906, leg. l. Romell (UPS); 1316.- *Ibidem*, 9.9.1900, leg. L. Roell (UPS); 1317.- Gotland, Väslainde, San Salthamin, vidstranden *Pinus* och *Juniperus* på sand och grus, 8.10.1953, leg. B. Pettersson (UPS); 1319.- Gotland, Gotska Sandön, Arnagropen nära aspkullen i norr, lilapperfältet, 9.8.1937, leg. B. Petterson 357 (UPS); 1321.- Uppland, Gandva, leg. M.A. Lindblad (UPS); 1323.- Gotland, Norrlanda sn, stranden, 19.9.1964, leg. G. Eriksson, as *R. vulgaris* var. *intermedia* Svrček (UPS); 1325.- Bohusland, Lilla växthuut, 3.1906, leg. Th. Fries (UPS); 1327.- Norrbotten, Piteå, Glisberget, 1870, leg. N.N. Lundström (UPS); 1329.- Norrbotten, Övertorneå sn, 10.10.1948, leg. O. Lönnquist (UPS); 1330.- Uppland, Bondkyrka sn, Graneberg, 1893, leg. Th.M. Fries (UPS); 1332.- Uppland, Mellanstäket, 8.1889, leg. K. Starbäck, as *R. rubescens* Tul. (UPS); 1334.- Södermanland, Helgesta sn, Aspö gård, 20.8.1915, leg. I. Örtendahl (UPS); 1335.- Uppland, Danmark sn, Bergsbrunna, 8.1883, leg. H. Juhlin-Dannfedt (UPS); 1337.- Uppland, Upsala, Graneberg, 28.8.1887, leg. Th. Fries, as *R. rubescens* Tul. (UPS); 1338.- Uppland, Stockholm skärgård, Kiludden, 8.1895, leg. Hj. Fries, as *R. rubescens* Tul. (UPS); 1340.- Dalarna, Carpenberg par., 3 Km SW of Carpenbergs gård, coniferous forest, 31.8.1974, leg. N. Lundquist 9477 (UPS); 1385.- Småland, Femsjö, Rävängsbacken, zwischen Steinen am Strand bei *Pinus*, 8.9.1974, leg. M. Moser (IB); 1386.- Gotland, Vetterheide, 6.9.1903, leg. F. Stålhandske, as *R. luteolus* Fr. (LD); 1390.- Skåne, Åhus, tallplantering, 9.1883, leg. L.J. Wahlstedt, as *R. provincialis* Tul. (GB); 1411.- Gotland, Lummelunda sn, Etebols, 11.9.1949, leg. E. Th. Fries (UPS); 1424.- Gotland, Gotska Sandön, Nordligaste delen, Dynkärret strax söder om Bredsandsudde, I sand bland de lågvuxna tallarna in mot kärret, Gulartad, övre dele exponerad över sanden, 19.7.1973, leg. L.E. Kers 3970, as *R. luteolus* Fr. & Nordh. emend. Tul. (S); 1426.- Uppland, Älvkarleby sn, Bremsand, tallskog på sand, 24.9.1950, leg. G. Fåhraeus & G. Stenlid (UPS); 1427.- Medelpad, Haverö sn, Östavalls järnvägsstation, 9.1886, leg. C.L. Hallberg (UPS); 1428.- Uppland, Älvkarleby sn, Brämsand, 29.9.1946, leg. R. Santesson (UPS); 1429.- *Ibidem* 1428, 30.9.1945, leg. G. Sandberg (UPS); 1430.- Västmanland, Sala, nära, 22.9.1942, leg. G. Degeliu, as *R. luteolus* Fr. (UPS); 1431.- Skåne, Åhus sn, Täppet, tallplantering, 9.1883, leg. L.J. Wahlstedt, as *R. provincialis* Tul. (UPS); 1432.- Jämtland, Alsen, 1902, leg. C. Sandell, as *R. rubescens* (UPS); 1433.- Norrbotten, Övertorneå sn, Isovara, N-sluttningen, ca. 1.5 km SW om sockenkyrkan, på grusig stig i barrskog, 24.8.1957, leg. O. Lönnquist 345 (UPS); 1434.- Norrbotten, Övertorneå sn, 2 km W om Övertorneå, 9.9.1950, leg. O. Lönnquist (UPS); 1435.- Norrbotten, Nedertorneå, Vusno, 17.9.1949, leg. E. Julin, as *R. luteolus* (UPS); 1436.- Gotland, Othem, 9.1984, leg. K. Johansson (UPS); 1440.- *Idem*, as *R. luteolus* Fr. (UPS); 1437.- Norrbotten, Övertorneå sn, ca. 2.5 Km S om kyrkbyn, på stig i tallskog från gamla vägen mot stora landsvägen, 2.9.1957, leg. O. Lönnquist 369 (UPS); 1438.- Jämtland, 1869, leg. Cederström, as *R. luteolus* Fr. (UPS); 1439.- Gotland, Hejdeby, N om kyrkan, bar flách i hallmarhstallshog, 24.8.1946, leg. B. Petterson (UPS); 1441.- Blekinge, Sölvesborg, Stadsskogen, close to the ship-yard, on sandy beach-meadow with sparse low pines, 2.10.1946, leg. S. Lundell & S. Wikland (Fungi exsiccati Suecici, Præsertim Upsaliensis 2257) (UPS); 1460.- *Idem* (S); 1572.- *Idem* (PR 619000); 1723.- *Idem* (PC); 1442.- Gotland, Buttle,

SW Altajme, gräshlädd grusbacke, f.d. grustag på pångstig, 2.9.1946, leg. B. Pettersson (UPS); 1445.- Norrbotten, Övertorneå sn, Isovaaras västra sluttning på sandig stig, 29.8.1954, leg. O. Lönnquist 70, as *R. lutescens* (UPS); 1450.- Södermanland, Ösmo sn, Nynäs, 9.1888, leg. K. Bohlin (S); 1451.- Gotland, Kräcklinbo, Hammarudden, på gräsmark under gran, 26.8.1896, leg. Grönvall (S); 1456.- Uppland, Stockholm, Bergränska Trädgården, nära högsta punkten av trädgården, nära "skogsdamen", odlingsland med Penstemon, ej. grävd på åratal, tallar, 21.9.1978, leg. L.E. Kers 6001, as *R. rubescens* Tul. (S); 1459.- *Ibidem*, 9.8.1978, leg. L.E. Kers 6002, as *R. rubescens* Tul. (S); 1457.- Södermanland, Hölö socken, 1.2 Km NV om gården Skyttorp Stort sandtag i vägkorset, I bottnen av sandtaget, svagt mossig sandmark, 1.9.1977, leg. L.A. Janzon, as *R. rubescens* Tul. (S); 1458.- *Ibidem*, på svagt mossbeklädd sandjord i bottnen av sandtaget, i söder, 3.9.1977, leg. L.E. Kers 6003, as *R. rubescens* Tul. (S); 1461.- Gotland, Visby, 17.9.1893, leg. T. Vestergren, as *R. rubescens* (S); 1462.- Uppland, Gustavisberg, Mörtnäss, på sandig väg, 8.1887, leg. H. Kugelberg (S); 1463.- Halland, Göteborg, landvetter, skogsiväg, leg. J. Lindström (S); 1468.- Uppland, Skoklosters sn, Tyberget på Arnöhuvud längs Mälaren, 14.8.1979, leg. E. Plalm (S); 1478.- Dalarna, Leksands socken, Tibble, utefter Österdälven, med sand igenfylld myrsvacka, tallplantering (ca. 10 år.), på sanding grovmo, sparsans moss-lauvëgetation, 15.9.1974, leg. L.E. Kers 4182, as *R. vulgaris* (Vitt.) M. Lange (S); 1480.- Dalarna, Leksands socken, Tibble by Längs Österdalälven, myr som utfyllts med sandjord (muddermassa från älven) och planterats med tall, ricklig i sandjord, delvis uppstickande, 3.10.1978, leg. L. E. Kers 4977, as *R. vulgaris* (Vitt.) M. Lange (S); 1481.- Uppland, Låssa socken, nära Sjö herrgård, saandig tallskog i sluttning ner mot Mälaren, nära vägen till Malaris monophyllakärret, delvis uppstickande ur marken, längs vägkant, 8.9.1978, leg. L.E. Kers 6005, as *R. vulgaris* (Vitt.) M. Lange (S); 1482.- Jämtland, Klövsjö, at the river Ljungan, near budge, appr. 13°59'E, appr. 62°41'N, 14.8.1981, leg. R.A. Hintz, as *R. vulgaris* var. *intermedia* Svrček (S); 1483.- Uppland, Täby socken, Mörtsjöns nordöstra strand, mossing bariskog, på stig, sanding-moig jord, 13.8.1978, leg. E. Holmberg, as *R. vulgaris* (Vitt.) M. Lange (S); 1485*.- Södermanland, Sparrekolm, Aspö Gård, 20.8.1916, leg. J. Ärtendahal (UPS); 1486*.- Jämtland, Th. Ostavall station i slut af., 9.1886, leg. C.L. Helleberg (UPS); 1487*.- Gotland, Martobo myr, 9.10.1892, leg. M. Larsson (UPS); 1488*.- Skåne, Täppetnäre, Åkus, 8.1889, leg. L.J. Wahstedt, as *R. provincialis* Tul. (UPS); 1489*.- Jämtland, Ragunda, 1912, leg. A. Frisendahl (UPS); 1490*.- Gotland, Invik, strand, äng i jordbrynat, 26.9.1914, leg. Sennarden (UPS); 1491*.- Uppland, Bergsbrunna, 25.8.1883, leg. H. Jahlin-Dannfelt (UPS); 1492.- Västerbotten, Umeå, 3 km S of lake Piparbötesjön, 24.9.1973, leg. Åke Strid 13892, as *R. roseolus* (Corda) Hollós (Jeppson); 1493.- Bohuslän, Tjärnö, Sydkoster, Kilesand, sandy pine forest near sea shore, 6.10.1988, leg. M. Jeppson, as *R. roseolus* ss Lange (Jeppson 2728); 1495.- Västmanland, Viker, Sjöändan, road side in coniferous forest on limerich soil, 20.8.1988, leg. M. Jeppson (Jeppson 2512); 1641.- Östergötland, Etelä-Karjala, Virolahti, Hallä, pine heath knoll at site of acamping place near seashore, Grid 27°E 671:54, 13.9.1973, leg. T. Rintanen (OULU); 1754.- Uppland, Flottsand, 1893, leg. Th.M. Fries, as *R. rubescens* Tul. (H); 1972.- Skåne, Åhus, Vabret, byandplatsenskant, 3.9.1922, leg. B. Hägg (UPS); 2444.- Uppland, Rosendal, *Picea abies*, *Pinus*, 14.10.1993, leg. T. Unestan et al. (BCC-MPM 1871). **SWITZERLAND**: 1564.- Valais, Saviése, dans les aigulles de *Pinus sylvestris*, 11.6.1977, leg. O. Monthoux 7075, as *Melanogaster broomeianus* Berk. (GK 12905); 1615.- # Délamont, 5.1908, leg. Butignot, ex Herb. Boudier, as *R. rubescens* (PC). **UNITED KINGDOM**: 1363.- Scotland, Culbin Sands, under *Pinus sylvestris* & *Pinus radiata*, 8.9.1975, leg. R. Watling & J. Waray, ex Herb. Watling 11597, as *R. rubescens* Tul. (E); 1364.- Scotland, ? Rottienwchis (Flora of Inverness), sandy grand, 12.8.1984, ex Herb. Watling 17400, as *R. rubescens* (E); 1365.- Scotland, Glen Tana estate (Flora of Aberdeenshire), small one attached to wood on path side, 15.8.1964, leg. R. Watling 560, as *R. rubescens* (E); 1558.- England, Freshfield, Lancs, hypogeous in sandbank near *Pinus* sp., 8.10.1955, leg. S. bates, det. J.T. Palmer ex Herb. Palmer 578, ex Livu Mycol 1236, ex Herb. Hawker (K); 1559.- Scotland, Perthshire, Black Wood of Rannock, 26.8.1954, leg. D.M. Henderson, ex Herb. Palmer

296, as *R. luteolus* Fr. (K); 1560.- *Idem*, ex Herb. Palmer 298 (K); 1707.- England, Knight Wood, New Forest, 13.9.1954, leg. L.E. Hawker 1077, as *R. vulgaris* (Vitt.) M. Lange (K).

Extralimital collections. ARGENTINA: 1471.- Sopra il Bonolo del Merlo-Quigno, 1883, as *R. rubescens* Tul. (S); CHINA: 1352.- Yünnan bor.-occid., in regionis calide temperate ad austroorient. pagi Dschungdien ("Chungtien"), pinetis apertis inter ricos Sape et Haba, substr. arenaceo, 2800 m, 2.8.1914, leg. H. Handel-Mazzetti, as *R. rubescens* Tul. (Handel-Mazzetti, Iter Sinense 1914-1918 N° 4405) (WU); 1588.- *Idem* (W 25024); 1590.- *Idem* (Handel-Mazzeti, Iter Sinense 1914-1928 N° 12944) (W 6998); 1354.- Yünnan bor.-occid., Circa vicum Ngulukö prope urbem Lidjiang ("Likiang"), in regione temperata, 9/10.1916, leg. Indigeni, as *R. rubescens* Tul. (Handel-Mazzetti, Iter Sinense 1914-18, N° 12944) (WU). INDIA: 1582.- Bhilari, at base of *Quercus incana*, 20.9.1977, leg. I. Alexander, as *R. luteolus* (E). NEW ZEALAND: 1388.- Maungaroa, Ins. boreal, 7.1874, leg. S. Berggren 163, as *R. luteolus* Fr. (LD); 1418.- *Idem* (S). UNITED STATES: 1225.- Idaho, Valley Co. Boise National Forest, Stolle Meadows, under Douglas fir & ponderosa pine, 15.8.1958, leg. A.H. Smith 60079, PARATYPE of *R. rubescens* Tul. var. *ochraceus* A.H. Smith (UPS); 1226.- Idaho, Idaho Co., Seven Devils Mountains, Heaven's Gate Ridge, under white bark pine & alpine fir, 2.8.1958, leg. A.H. Smith 59481, PARATYPE of *R. rubescens* Tul. var. *ochraceous* A.H. Smith (UPS, slide BCC-MPM 2028); 1500.- *Idem*, ex Herb. Smith 59476, PARATYPE of *R. rubescens* Tul. var. *ochraceus* A.H. Smith (S); 1501.- *Idem*, ex Herb. Smith 59520, PARATYPE of *R. rubescens* Tul. var. *ochraceus* A.H. Smith (S); 1289.- South Carolina, Hillsborough, in terra arenosa Pinetorum, leg. M.A. Curtis, as *R. rubescens* Tul. (UPS); 1290.- North Carolina, Chapel Hill, Orange Co., campus de l'University of Carolina, pelouse sous *Pinus taeda*, 10.11.1970, leg. V. Demoulin 4104, as *R. vulgaris* (Vitt.) M. Lange (LG, slide BCC-MPM 1416); 1345.- South Carolina, in arenosis, leg. Curtis, as *R. rubescens* Tul. (STR); 1399.- California, Ingleside Distrited, South of Yolden, Made Park, Sant Francisco, under leaves, beneath *Eucalyptus* and pinus trees, 10.1904, leg. W.Z. Jardum, as *R. provincialis* Tul. (M); 1419.- Washington, Takoma Park, ground among lichens, open places in pine woods, 11.1900 as *R. rubescens* Tul. (Ellis and Everhart's Fungi Columbiani Continued 1413) (HBG); 1472.- *Idem* (S); 1566.- *Idem* (G); 1455.- Ohio, Cincinnati, leg. C.G. Lloyd 5603, as *R. provincialis* Tul. (S); 1464.- California, San Francisco, Golden Gate Park, 15.3.1923, leg. H. E. Parks 1980, as *R. rubescens* Tul. (California Fungi 559) (S); 1567.- *Idem* (G); 1586.- *Idem* (W); 1465.- New Jersey, Newfield, ad terran arenosam, 12.1874, leg. J. B. Ellis, as *R. rubescens* Tul. (S); 1475.- Florida, on sandy ground in pine barrens, 23.1.1901, leg. A.S. Bertolet, as *R. rubescens* Tul. (S); 1502.- Idaho, Valley Co, Lake Fork Creek, 13.7.1958, leg. T. Wsterdale, ex Herb. Smith 58821a, as *R. rubescens* Tul var. *pallidimaculatus* A.H. Smith (S); 1755.- Massachusetts, Franklin Co., South Deerfield, Whately, Sandy Pine Barrens, in sandy soil, associated with *Pinus rigida*, 11.10.1982, leg. R.E. Halling & B.M. Thiers 3555, as *R. vulgaris* var. *intermedius* Svrček (H); 1763.- Oregon, Deschutes County, Bend, hypogeous in beds of *Pinus ponderosa* and *P. contorta* seedlings in U.S. Forest Service Nursery, 20.10.1975, leg. R. Molina & J. Trappe 4503, as *R. vulgaris* (Vitt.) M. Lange Trappe 4503 (LG, slide BCC-MP 1415); 2371.- Idaho, Blind Summit, Stanley, Custer Co., 23.7.1962, leg. A.H. Smith 65485, as *R. roseolus* Fr. ss A.H. Smith (MICH)

Unknown locality. 1318.- ? Wermland, leg. Fr. Laurell (UPS); 1378.- Illegible loc., 9.9.1914, as *R. rubescens* (C); 1470.- Illegible loc., 6.10.1919, leg. Sigrid Wahlgren, as *R. roseolus* Tul. (S); 1474.- Without loc., subpine sylvestris, leg. G. Bresadola, as *R. rubescens* Tul. (S); 1477.- ? Tajo, in pinety, 7.1916, leg. Bresadola, as *R. virens* Alb. & Schw. (S); 1551.- Without data, Rabenh. 292 as *Hyperrhiza tuberiformis* (BP 22314); 1569.- Without loc., se trouve sous un terrain sablonneux ex Herb. de Candolle, as *R. virens* Fr. (G); 1570.- Without loc., in pinetis sabl. sylvat., 1856, ex Herb. Barbey-Boissier, as *R. luteolus* (G); 1589.- Without data, Hildebrand Herb. cryptog. (W); 1720.- Illegible loc., 14.6.1916, as *R. rubescens* (JE).

C.- Collections with spore volume betwen 37.6 and 52.5 mm^3

European collections. **AUSTRIA**: 495.- Tirol merid., Perdonig in fageto, 9.1869, leg. C. Heufler, as *R. rubescens* (UPS); 503.- Hainfeld, Michelbach, 450 m, 8.6.1986, leg. W. Klofac, as *R. vulgaris* (Vitt.) M. Lange (WU 5907); 504.- Neunkirchen, Mollramn Pinus-Jungwald, 20.10.1987 leg. W. Klofac (WU); 505.- Wien-Lobau, 24.8.1982, leg. H. Kaecht (WU 3203); 512.- Eberstein, 24.9.1986, leg. G. Lysek (BSD 361); 516.- Telfs, in Gras am Waldrand, leg. Kreß, as *R. luteorubescens* A.H. Smith (Groß 820); 593.- Igls. pr. Innsbruck, 800 m, 6.1891, leg. Santhein, as *R. virens* (Alb. & Schw.) Fr. (S); 672.- Nachst Absam bei Hall, Jn sandigem Boden im Coniferen-Wald, halbhervorragend, 12.8.1930, leg. V. Litschauer, as *Rhizopogon aestivus* (Wulf.) Fries (V. Litschauer, Fungi Tirolenses exsiccati 171) (W 2838); 673.- Nord-Tirol, Hügel bei Reutte, aüf einem gravigen, 8.1927, leg. K. Keissler (W); 674.- Nord-Tirol, bei Weißenbach, Lechtal, in einer Wiese, 8.1927, leg. K. Keissler, as *R. rubescens* Tul. (W 16941); 675.- Steiermark, 1000 m, 7.1912, leg. K. v. Keissler, as *R. rubescens* Tul. (W 119); 678.- Nied.-Österreich, Maner, 7.5.1916, ex Herb. P. Demelius 1087, as *R. luteolus* Tul. (W 2033); 1058.- Imst, *Picea abies* auf Kalk, 7.1988, leg. Schmitt as *R. rubescens* var. *rubescens* A.H. Smith (Groß 798); 532.- # Tirol, Klausboden, Piller, Pitztal, bei Kiefern, 14.8.1975, leg. M. Moser, as *R. rubescens* (Tul.) Tul. (IB). **BELGIUM**: 470.- Namur, Telenne, sur sol argileux sous *Pinus sylvestris* au bord d'un sentier forestis à Molinia cocruela, au lieu dit "La Minière" entre l'Ancien Moulin d'Olenne et de Village de Telenne, 300 m, 5.10.1975, leg. A. Marchal 75056 (LG, slide BCC-MPM 1418); 471.- Namur, Han-sur-Lesse, Roches à Serins, bois mélé (*Pinus sylvestris* et *P. nigra*), thermophile sur calcaire, 9.10.1987, leg. V. Demoulin (LG, slide BCC-MPM 1419); 473.- *Ibidem*, pelouse calcaire thermophile à proximité de *Pinus sylvestris*, 7.10. 1988, leg. V. Demoulin (LG, slide BCC-MPM 1423); 472.- Soy, Biron, hypogé sous *Quercus robur* à proximité de *Pinus sylvestris*, 8.9.1968, leg. V. Demoulin (LG, slide BCC-MPM 1424). **CZECH REPUBLIC**: 438.- Bzenec, les "Dúbrava", in pineto arenoso, 4.7.1955, leg. F. Smarda, TYPE of *R. tenuisporus* var. *intermedius* Svrček (PRM 742575, slide BCC-MPM 2180); 502.- Bei Budnan, 20.5.1920, ex Herb. Beck 1628 (PRM); 538.- Namiest, in pinetis leg. Niessl, as *R. rubescens* Tul. (RO); 649.- Hády pr. Brno, in querceto-carpineto, 5.1952, leg. J. Spacek (PRM 619006); 650.- Bohemia, Vonoklasy, in silva arenosa (*Picea*, *Pinus silv.*), 11.7.1945, leg. A. Daubová (PRM 618978); 652.- Bohemia centr., Senohraby, in silva frondosa mixta, 8.1955, leg. Knettl (PRM 742565); 653.- Pradice-Jedlany pr. Tábor, in carbonario silv., 15.8.1966, leg. et det. M. Svrček as *R. roseolus* var. *foetens* Svrček (PRM 618989); 654.- Svinošice pr. Tišnova, silva "Dubová hora", silva frondosa Quercus, Fagus, 1.9.1940, leg. F. Smarda, ex Herb. Svrček 1956 as *R. roseolus* var. *foetens* Svrček (PRM 618988); 655.- Veverská, Bítýska pr. ruinam Veverí, 350 m, in piceto, 12.7.1954, leg. K. Kriz ex Herb. Svrček 1956 as *R. roseolus* var. *foetens* Svrček (PRM 618986); 676.- Mähren, Steinerberg-Gebiet, Iglau, im Waldboden, 26.8.1923, leg. Canon, as *R. rubescens* Tul. (W 15131); 636.- # Lucsivna, leg. Kalchbrenner, as *R. rubescens* Tul. (BP 22308); 637.- # Késmárk ex Herb. F. Hazslinskyi, as *R. rubescens* Tul. (BP 22306); 657.- # Bohemia merd., Salmanovice, pinetum, 2.7.1964, leg. J. Kubicka as *R. roseolus* var. *sulphureus* (Vel.) Svrček, (PRM 603783); 658.- # Moravia, Zărošice, in silva mixta (*Carpinus*, *Fraxinus*, *Quercus*, *Pinus sylvestris*), 9.9.1949, leg. V. Vacek *as R. graveolens* Tul. sensu Vel. (PRM 619035); 659.- # Moravia meridionalis, Ždánsky les. Zărošice, 1950, leg. V. Vacek as *R. graveolens* sensu Vel. (PRM 619030). **DENMARK**: 525.- Jylland: Ho, Klithede (Ubeplantet), 9.1930, leg. C.A. Jorgensen, as *R. luteolus* Fr. (C); 526.- Sjælland: Asserbo Plantage, 5 Km N of Fredriksværk Plantage, 14.9.1968, leg. studenterekskursion, as *R. luteolus* Fr. (C). **ESTONIA**: 630.- Haapsalu, insula Vormsi, Runpo, sat raro ad terram in pinetis et in fruticetis junipereis, ad terram lapillosam in fruticeto junipereo, 7.7.1960, leg. H. Trass et E. Parmasto (Mycotheca Estonica, Fasc. III) (MA-Fungi 2845); 693.- Distr. Haapsalu, insula Vormisi, sansby, 19.9.1980, leg. L. Jàrva (TAA 93536). **FINLAND**: 489.- Tavastia australis, Tammela, Mustiala Fennia, Sept., leg. P.A. Karsten, as *R. rubescens* Tul. (UPS); 620.- Regio aboënsis, Åbo, Pargas, *Pinus* forest on calcareous soil, 22.8.1986, leg. M. Jeppson (Jeppson 2209); 621.- *Ibidem*, under *Pinus sylvestris* on calcareous soil, 22.8.1986, leg. M. Jeppson (Jeppson 2210); 712.- Sompio Lapland, Savukoski, Tulppio, Tulppionkariste, 245 m, Grid 27° E 7522:592, on ultramafic soil under *Pinus sylvestris*, visible at soil surface, 30.7.1988, leg. T. Ahti 47587 (H); 713.- Satakunta, Tyrvis (=Vammala, Tyrvää), 7.9.1859, leg. P.A. Karsten 3697 (H); 714.- Tavastia australis, Tammela, in Syrjä (Mustiala-W), 14.9.1904, leg. Alumnus Öhberg, ex Herb. Karsten 3700, as *R. rubescens* Tul. (H); 715.- Nylandia, Nurmijärvi, Kirkonkylä, Härkähaka, Grid 27° E 6706: 380, havumetsä, tienreuna, 25.10.1983, leg. P. Askola 1317 (H); 716.- Regio aboënsis, Lohjan kunta, Laakspohja, Lohjanharjulla (mänty, kuusi, koivu, lehtikuusi), 8.1991, leg. S. Siltala, as *R. rubescens* (H); 717.- Regio aboënsis, Pargas, Mattholm, 8.1917, leg. E. Munsterhjelm (H); 718.- Nylandia, Borgåsocken, Firmo, 1925, leg. W. Nyberg, as *R. rubescens* Tul. (H); 719.- Nylandia, Tammisaari, Ramsholm, 11.7.1960, leg. O. von Schulmann, as *R. rubescens* Tul. (H); 720.- Nylandia, Grankulla, väg under tall, 22.8.1948, leg. W. Nyberg, as *R. rubescens* Tul. (H); 721.- Regio aboënsis, Korpo, 9.1941, leg. O. Eklund, as *R. rubescens* Tul. (H); 722.- Nylandia, Grankulla (=Kauniainen), Grid 27°E 667-68:37, UTM LG1, leg. Wolmar Nyberg, as *R. rubescens* Tul. (H); 727.- Nylandia, Ekenäs Tvärminne, 4.9.1948, leg. H. Luther, as *R. luteolus* Fr. (H); 728.- Tavastia australis, Janakkala, 29.8.? (without year, but vidi Th. Fr. 1901), leg. F. Elfving (H); 729.- Nylandia, Ingå, Fagervik i parken, 9.1897, leg. P.A. Karsten 3702, as *R. luteolus* Fr. (H); 730.- Regio aboënsis, Åbo, Runsala (=Ruissalo), in terra, 13.9.1866, leg. P.A. Karsten, as *R. luteolus* Fr. (H). **FRANCE**: 439.- France, 6.1902, leg. Boudier ex Herb. G. Bresadola 1802, TYPE of *R. briardi* Boud. (M, slide BCC-MPM 2107); 440.- Environs de Troyes (Aube), 7.1883, leg. Briardi, as *R. briardi* Boudier (G. Roumeguère, Fungi Gallici exsiccati 3661) (PC, slide BCC-MPM 2097); 442.- *Idem* (PAV); 443.- *Idem* (DBN); 627.- *Idem*, (UPS); 444.- Saint Bon, 7.1882, as *R. briardi* Boudier (PC); 445.- Charleville, 6.1902, leg. D. Kaslay, ex Herb. Boudier, as *R. briardi* (PC, slide BCC-MPM 2096)(In the same enveloppe that 446); 446.- Brienne, 8.1893, leg. D. Bertrand, ex Herb. Boudier, as *R. briardi* Boud.(PC); 474.- Entre Saint Jurson et Le Chaffont aus SW de Digne (Basses-Alpes), sous *Pinus sylvestris* et *Juniperus communis* sur sol argileux, 31.9.1972, leg. V. Demoulin 4419 (LG, slide BCC-MPM 1427); 475.- Env. 5 Km av. Mirabeau en venant de Gambois, sous *Pinus halepensis* et à proximité de *Pinus sylvestris*, 10.11.1968, leg. V. Demoulin 3794 (LG, slide BCC-MPM 1428); 476.- Entre St. Paul-en-Forêt et Bagnols-en-Forêt, sous *Pinus pinaster*, 12.11.1968, leg. V. Demoulin 3820 (LG, slide BCC-MPM 1429); 477.- Forêt de la Ste-Baume, sous *Pinus sylvestris* et *Juniperus communis*, 8.11.1968, leg. V. Demoulin 3784 (LG, slide BCC-MPM 1425); 478.- Ardennes, au N au village de Chémey (env. 30 Km au N de Vouziers), pelouse sur calcaire bathonien plantée de jeunes *Pinus sylvestris* et *Picea abies*, 5.6.1976, leg. V. Demoulin (LG, slide BCC-MPM 1426); 481.- Nevaches, sol légèrament calcaire, dans un bois de pins à crochets assez dense sur la rive gauche et à proximité de la Clarée, près de la chapelle St.-Sauveur, 1550 m, 30.7.1967, leg. G. Clauzade (LG, slide BCC-MPM 1438); 522.- Provence, Vaucluse, Caseneuve, in *Pineto-Quercetum ilicis*, 43 50 15 N-5 20 E, 350 m, 17.10.1990, leg. G. Negrean, *as R. luteolus* Fr. & Nordh. (BUCM 118006); 599.- Nice, leg. Barla, as *R. provincialis* Tul. (S); 647.- *Ibidem*, 1.1883, leg. Barla (PC); 617.- France, leg. Quèlet, as *R. rubescens* (S); 624.- Région littorale, "Drap", "Montagne", "Berna", "Montdaour", Automne-Hiver 1885, leg. J.B. Barla as *R. luteolus* Fries (Roumeguerè, Fungi Gallici Exsiccati 3825) (UPS); 625.- Sur les talus sablonneux, sur les grès vosgien (Raon) et sur les grès rouge (Saint-Dié), november 1894, leg. R. Ferry as *R. luteolus* Fr. (Roumeguère, Fungi selecti exsiccati 6781) (UPS); 645.- Bois de a "Mairis" "Drap" "Nice", règion littorale et montagneuse, automne 1885 as *R. provincialis* Tul. (Roumeguère, Fungi Gallici exsiccati 3826) (BP 22300); 663.- Massif des Baumes, 10.1974, leg. G.A. de Vries (Vries 648); 664.- Ardennes, bois de Famenne, 26.9.1974, leg. C.A. de Vries (Vries 629); 665.- Revest-de-Bion, sub *Quercus pubescens* et *Pinus sylvestris*, 28.10.1974, leg. G.A. de Vries (Vries 639); 666.- *Idem* (Vries 640); 691.- La Mothe St. Heray, 1897, leg. Dupain ex Herb. Boudier, as *R. luteolus* (PC); 708.- Drap, mont. de Brou, Automne 1886, leg. J.B. Barla, as *R. provincialis* Tul. (JE); 709.- *Idem* (JE); 731.- *Idem* (JE); 732.- *Idem* (JE); 711.- Berra, 1.1886, leg. J.B. Barla, as *R. luteolus* Fr. (PC); 441.- # Montsuzain, Bois du Bigot, 8.1881, as *R. briardi* Boud. (PC). **GERMANY**: 479.- Krs. Lichtenfels, Kleinziegenfeld, Trockenrasengebiet auf

Kalk, MTB 5933, 6.11.1977, leg. H. Engelk D 94 (LG, slide BCC-MPM 1437); 480.- Lichtenfels Spitzberg bei Romansthal, Nordbayern, MTB 5832, im Kiefernwald (*Pinus sylvestris*), lehmiger, kalkhaltiger Boden, 28.5.1978, leg. H. Wirth (LG, slide BCC-MPM 1440); 501.- Budenheim, in pinetis, leg. Fuckel, as *R. luteolus* Fr. (STR); 513.- Brandenburg, Kirchhofen-Spreenhagen, kr. Storkow, sandige Kiefernschonung *Pinus sylvestris*, 4.10.1987, leg. U. Richter (LZ 4258); 515.- Saar, Homburg, *Pinus sylvestris*, Buntsandstein, 7.10.1981, leg. Groß (Groß 813); 543.- Reichenberg bei Würzburg, Eichen-Buchenwald, 31.7.1923, ex Herb. Soehner 745, as *R. rubescens* Tul. (M); 544.- Unterfranken, Karlstadt, Mänsberg, MTB 6024, Karst, unterer Muschelkalk, 8.8.1981, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 545.- München Isarauen, auf Erde in Sandingen Waldernum Heiden halbauschen Baden hervorrangend, 17.5.1885, leg. Alleschers, as *R. rubescens* Tul. (M); 547.- Wertheim, Lindelbach, MTB 6223, 6.6.1981, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 548.- *Idem* (M); 549.- *Ibidem*, Kiefer + Buche, 17.7.1982, leg. R.A. Hinzt (M); 550.- *Ibidem*, 29.5.1981 (M); 551.- *Ibidem*, Fagus, 27.6.1981, leg. R.A. Hintz (M); 553.- *Idem* (M); 554.- *Ibidem*, *Quercus*, *Pinus*, 14.8.1982, leg. R.A. Hinzt (M); 558.- *Ibidem*, *Pinus*, 29.5.1981, leg. R.A. Hintz (M); 559.- *Ibidem*, 6.6.1981, leg. R.A. Hintz (M); 560.- *Ibidem*, 6.6.1982, leg. R.A. Hintz (M); 562.- *Ibidem*, 27.6.1981, leg. R.A. Hintz (M); 552.- Bayern, Pupplingertu, 9.1894, leg. A. Progel, as *R. rubescens* Tul. (M); 555.- In pinetis prope Fr. Weinheim, non frequens, Autumno, as *R. rubescens* Tul. (M); 556.- Haar bei München, Fichten-Jüngholz, 1.9.1944, ex Herb. Soehner 2076, as *R. rubescens* Tul. (M); 557.- Selönherg bei Grafenaü, Bayer Wald, aut granitsand mit Hümus, 8.8.1922, ex Herb. Soehner 652, as *R. rubescens* Tul. (M); 561.- Unterfranken, Gemünden, Uhlberg, MTB 5924, Karst, unterer Muschelkalk, *Fagus*, *Pinus*, *Sorbus*, 17.6.1983, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 564.- Unterfranken, Gemünden, Ständelberg, MTB 5924, Karst, unterer Muschelkalk, 30.8.1981, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 565.- *Idem* (M); 567.- *Idem* (M); 569.- Budenheim, in pinetis, raro, Autumno as *R.virens* Fr. (Fuckel, Fungi Rhenani 1252) (M); 571.- Ettersberg bei Schellenberg, 950 m, leg. Soehner 1257, as *R. rubescens* Tul?, *R. provincialis* Tul. ? (M); 573.- Schwenningen, Fi-wald, 12.9.1949, leg. H. Hass, ex Herb. Soehner 1155, as *R. occidentalis* Zeller et Dodge (M); 574.- Leuna, 11.1894, leg. S.Friedi, as *R. aestivus* (HBG); 575.- Illegible loc., 8.9.1920, leg. M. Moskay, as *R. rubescens* (HBG); 576.- Stadtilm Thüringer, auf dem Buchberge am Schlangenwege auf Muschelkalkboden, 30.8.1928, leg. Gierlof, as *R. rubescens* (HBG); 577.- *Idem* (HBG); 578.- *Ibidem*, 29.11.1928, leg. Gierlof (HBG); 579.- *Ibidem*, 30.8.1928, leg. Gierlof (HBG); 580.- *Ibidem*, 31.2.1928, leg. Gierlof (HBG); 581.- Illegible loc., 3.9.1989, as *R. rubescens* Tul. (HBG); 582.- Sajaone tridentina, pineti, 10.1893, leg. E. Gelm (S); 610.- Nördl Wächtesbach, Nächst der Sudbahnstation, *Pinus nigra* Wälder, 2.6.1939, leg. H. Huber, as *R. rubescens* (S); 635.- Klotzsche in Dietr., ex Herb. Rabenhorst 250, as *Hymenangium virens* (BP 22230); 638.- Neustadt, großer Föhren-wald, Gesellig in *Pinus nigra*-Wald mit *Plicaria coronaria* & *P. vesiculosa*, 30.5.1935, leg. H. Huber, as *R. aestivus* Fr. (BP 22318); 640.- Jena Somenberg, 2.7.1904, as *R. aestivus* Fr. (BP 22311); 667.- Gees, Eifel, under *Pinus sylvestris* on path in forest, 3.10.1971, leg. F. Tjallingii, as *R. luteorubescens* A.H. Smith (Vries 526); 690.- Marne, 1898, leg. Perr, ex Herb. Boudier, as *R. provincialis* (PC); 692.- Baden-Württemberg, Konstanz, Liggeringen, NE of the village, mixed forest (*Pinus*, *Picea*, *Fagus*) at the margin of cultivated filds, under pine, 1.10.1981, leg. E. Ohenoja (OULU); 695.- [Bayern, Niederbayern, N of Mühldorf a Inn] Ersharting, 29.7.1924, ex Herb. Soehner 865, as *R. rubescens* (M); 696.- Pupplinger Au, Lkr. Wolfratschausen, 9.1970, leg. Steglich & Zipfel (M); 698.- Schweuningen, Württemberg, leg. H. Etuttgart, ex Herb. Soehner 2371, as *R. angustisepta* Zeller & Dodge (M); 706.- Bad Kösen, Halbtrockenrasen bei *Pinus* 23.6.1985 (JE); 707.- Plane, Strubbelsbug über moos, Kieferer wald, 21.7.1978, leg. P. Ebest, as *R. rubescens* Tul. (JE); 733.- Im Budenbeimer Wald, auf Sand halb bedeckst in Kiefernwäldern selten im Herbst, 1894, leg. Herbice Fuckel as *Hysterangium clathroides* Vittad. (Leopold Fuckel, Nassau's Flora 1) (G 12875); 737.- Bei Budenheim, auf und unter dem Sand in Kiefernwäldern, häufig, im Herbst, as *R. rubescens* Tul. (G). GREECE: 726.- Rohdos, Mt. Kamiros, on soil with *pinus pinea* and scrub, 14.11.1972, leg. E. Koivisto (H). **Hrvatska** (ex Yugoslavia); 570.- Dalmatien, L. Ragnza, unter Olläumen, 30.3.1914, leg. O. Kaap as *R. aestivus* (Wulf.) Fr. ex Herb. G. Bresadola 1803 (M). **Hungary**: 633.- Szakonyfalu, Com. Vas., Luzulo-Fagetum, 3.10.1963, leg. Babosné & Bohus G., as *R. suavis* Quél. (BP 37134); 634.- Sopron, 5.6.1954, leg. Lenky J., as *R. aestivus* Fr. (BP 22298); 643.- *Idem* (BP 22305).639.- Mts. Pilis, 24.11.1957, leg. mycologists, as *R. aestivus* Fr. (BP 32021); 641.- Mts. Budai, Budakeszi versus Makkos Mária in pineto culto, 8.10.1967, leg. B. M., as *R. aestivus* Fr. (BP 48018); 642.- Prope Kajdaes (Comit. Tolna), sub *Juniperus communis* ad terram, 4.5.1928 ex Herb. Hollòs, as *R. aestivus* Fr. (BP 22316). **Italy**: 500.- Modena, pini, 31.3.1882, leg. O. Mattirolo 3238, as *R. rubescens* (PAD); 506.- Tirolo meridionale, nelle selve montane presso Bolzano, 1865, leg. Hausmann as *R. rubescens* (Erb. Crittogam. Ital.- Ser. II 42) (WU). 511.- *Idem* 506 (FI). 535.- *Idem* 506 (RO). 671.- *Idem* 506 (E); 509.- Firenze, Boschi di Vincigliata, 6.4.1916, leg. E. Pampanini, as *R. provincialis* Tul. (FI); 510.- Toscana, Selva di Aruvecchio, 17.9.1912, leg. M. Savelli (FI); 514.- Corsiga: Bonifato, 29.10.1982, leg. Sonneborn, as *R. luteorubescens* A.H. Smith (Groß 902); 518.- Febbio, Reggio Emilia, Emilia, *Pinus nigra & Picea abies*, Kalk, 26.6.1968, leg. Montecchi, as *R. rubescens* var. *rubescens* (Groß 980); 530.- Podelta, Ferrara, Romagna, Pinetum bei Lido di Volano, unter *Pinus pinaster*, 24.04.1977, leg. M. Moser, as *R. rubescens* (Tul.) Tul. (IB); 531.- [Prov. Sassari], Rena Maiore [c. 8 km SSW of S. Teresa di Gallusa], *Pinus halepensis*, 3.11.1983, leg. M. Moser (IB 83/544); 536.- Bolzano, leg. Haufmann (RO); 542.- Mendola, sub. pin. silv., 8. 1903, leg. G. Bresadola 1804, as *R. aestivus* (Wulf.) Fr. (M); 546.- Castelfondo, in pinetum, 8.1897, leg. G. Bresadola 1807, as *R. rubescens* Tul. (M); 587.- Mendola, Villa Salvador, ad terram sub pino silv., 1902, leg. Bresadola, as *R. virens* (Alb. & Schw.) Fr. (S); 2529.- Appiano Gentile, Pian Bosco, pino silvestre e castagno, humus acido, 19.9.1984, leg. A. Bincoletto, as *R. vulgaris* (Vitt.) M. Lange (Sarasini 108); 2530.- Baia Sardinia, Sassara, Sardegn, Pineta litorale, terreno con pino marittimo, 3.11.1984, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 145); 2533.- S. Vincezo (LI), Forte di Bibbona, macchia mediterranea con pini, 7.11.1987, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 286). 2539.- *Ibidem* 2533, 19.5.1990, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 384); 2534.- Punta Ala (GR), duna litorale, macchia con pino, 8.11.1987, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 292); 2537.- Pisa, Marina di Vecchiano, retrodune con pini, 28.4.1990, leg. A. Ricoletto & M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 381); 2541.- Cá Savio (VE), boschi del litorale, pini marittimo e domestico, 3.11.1991, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 427); 2544.- Bibione Pineda (VE), pineta con pini marittimi, 11.10.1992, leg. A. Bincoletto, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 463); 2545.- Riomaggiore, La Spezia, macchia con pini, 8.11.1992, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 469); 2548.- Pigna (IM), pino silvestre, 10.1993, leg. M. Rizzotto, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 574); 2549.- Fondo (TN), Regole, pino silvestre con larici e pecci, 17.9.1994, leg. M. Sarasini, as *R. vulgaris* var. *intermedius* Svrček (Sarasini 610). **Netherlands**: 521.- Hierden, Hulshorst, los op grond liggend, onder berk in gemengd loozbos, *Pinus*, 28.8.1958, leg. R.A. Mass Geesteranus, as *R. rubescens* Tul. (L); 528.- Maarssen, garden Pietheinstr. 29, near *Pinus*, 7/8.10.1986, leg. F. Smorenburg, as *R. luteorubescens* (Vries 1077); 529.- Leemkuilen, Staveren, prope *Pinus sylvestris, Betula & Salix* sp., 22.9.1983, leg. G.A. de Vries as *R. rubescens* (Vries 1050); **Norway**: 619*.- Aust-Ager: Lillesand, leg. O. Johan-Olsen (S). **Poland**: 534.- Truskaw, Kampinoski Park Narodowy (woj. Warszawskie), ad arenosos apriscosque ad pineti marginem, 20.9.1960, leg. W. Rudnicka-Jezierska, as *R. luteolus* Fr. (LD); 592.- Breslau (=Wroclaw), Sibesiae, 10.1872, leg. L. Becker, ex Herb. Winter as *Hymenangium virens* Klotzsch (S). **Portugal**: 519.- Estremadura, Sesimbra, Lagoa de Albufeira, em pinhal, 1.1991, leg. M.G. Almeida & F.D. Calonge PL2482 (LISU). **Russia**: 736.- Rodino, Collezione Mattirolo 197, ex Herb. De Candolle, as *R. rubescens* Tul. (G). **Slovaca Republic**: 507.- Prencow, Stankojo vrsok, 23.9.1907, leg. A. Kmet as *R. rubescens* Tul. (Fungi Schemnitzienses) (WU); 508.- *Idem* (WU); 734.- *Idem* (G); 651.- Slovakia centr., "Strázovská vrchovina", in

monte "Rokós", ad terram udem in fageto nudo, solo dolomitico, 3.7.1955, leg. L. et F. Kotlaborvr (PRM 742567). **Spain**: 449.- Barcelona, Platja de Castelldefels (Baix Llobregat), 3 m, UTM DF17, dunas fijadas con *Pinus pinea*, *Pistacia lentiscus* y *Rosmarinus officinalis*, 20.5.1985, leg. T. Franquesa, A. Perez & M. Aguasca (BCC-MPM 259); 450.- *Idem* (BCC-MPM 260); 451.- Barcelona, Calamot (Baix Llobregat), 265 m, UTM DF07, pinar, 20.5.1985, leg. T. Franquesa, A. Perez & M. Aguasca (BCC-MPM 261); 452.- *Ibidem*, pinar de *Pinus halepensis*, 23.5.1984, leg. X. Llimona (BCC-MPM 333); 453.- Barcelona, Molins de Rei (Baix Llobregat), encinar, margen de camino, 37 m, UTM DF18, 10.11.1985, leg. M.P.M. (BCC-MPM 532); 454.- Barcelona, Begues (Baix Llobregat), bajo *Pinus halepensis*, 350 m, UTM DF07, 17.11.1985, leg. A. Canals (BCC-MPM 545); 460.- *Ibidem* 454, entre raíces de pino, 15.10.1989, leg. A. Canals (BCC-MPM 1112); 455.- Girona, Torroella de Montgrí (Baix Empordà), 10.10.1991, leg. I. Borras, (BCC-MPM 1462); 2149.- *Ibidem*, asociado con raíz de *Helianthemum lavandulifolium*, leg. J. Blasco 4943 JB (BCC-MPM 1692); 2150.- *Ibidem*, b/ *Juniperus*, *Pinus* y *Rosmarinus*, 25.6.1992, leg. J. Blasco 4942 JB (BCC-MPM 2150); 497.- *Idem* (BCC-MPM 1801); 498.- *Idem* (BCC-MPM 1802).456.- Huesca, Centenera, cerca de La Puebla de Fontova, 5.1.1992, leg. I. Nadal (BCC-MPM 1488); 523.- *Idem* (BCC-MPM 1803); 457.- Barcelona, Vallgorguina, cerca del dolmen (Vallès Oriental), encinar con pinos, 8.6.1992, leg. F. Ximenec (BCC-MPM 1538); 458.- Barcelona, La Llacuna (Alt Penedès), bajo *Pinus halepensis*, 28.4.1988, leg. J. Llistosella (BCC-MPM 959); 459.- Barcelona, Sant Martí de Tous (Anoia), bajo *Pinus halepensis*, 23.10.1989, leg. N. Farré & J. Vila (BCC-MPM 1047); 461.- Barcelona, El Corredor (Maresme), bosque mixto de *Quercus* y *Pinus*, 20.10.1988, leg. Membres Soc. Cat. Mic. (BCC-MPM 1048); 462.- Barcelona, Vespella (Osona), bajo *Pinus halepensis*, 10.1990, leg. M. Tabarés (BCC-MPM 1715); 463.- Mallorca, Predio Son Bunyola, 2.12.1990, leg. J.L. Siquier (BCC-MPM 1714); 464.- *Ibidem*, 4.12.1990, leg. J.L. Siquier 72 G (duplex BCC-MPM 1713); 465.- Zaragoza, Pina de Ebro, Retuerta de Pina, bajo *Pinus halepensis*, 17.6.1990, leg. J. Blasco 1616 (duplex BCC-MPM 1705); 466.- Teruel, Valdelinares, estación de esquí, 13.5.1990, leg. F.D. Calonge (BCC-MPM 1706); 467.- Teruel, Sierra del Pobo, bajo *Pinus sylvestris*, 13.5.1990, leg. F.D. Calonge (BCC-MPM 1707); 468.- Teruel, Nacimiento del río Tajo, bajo pinos, 3.6.1988, leg. F.D. Calonge (BCC-MPM 1701); 524.- Mallorca, Castillo d'Alaro old mixed forest with *Pinus*, *Quercus*, *Arbutus*, *Pistacia*, *Smilax*, 24.11.1980, leg. H. Knudsen (C); 539.- Mallorca, Predio Es Guix, Escorca, bosque mixto de *Quercus ilex* y *Pinus halepensis*, 700-800 m, 17.11.1991, leg. J.L. Siquier 115 G (BCC-MPM 1510); 540.- Mallorca, Artá, Predio Son Not, bosque de *Pinus halepensis*, 225-250 m, 9.10.1991, leg. Julen ex Herb. Siquier 114 G (duplex BCC-MPM 1509); 541.- Mallorca, Calviá, Ses Algorfes, bosque mixto con *Quercus ilex*, *Quercus* coccifera, *Pinus halepensis*, *Cistus monspeliensis*, *Pistacia* sp, 250-300 m, 23.11.1991, leg. J.L. Siquier 117 G (duplex BCC-MPM 1512); 680.- *Idem*, leg. J.L. Siquier 117 G (duplex BCC-MPM 1619); 566.- Madrid, Sierra de Guadarrama, pinares de El Paular, 30.11.1972, leg. F.D. Calonge (MA-Fungi 4171); 628.- Madrid, Carretera de Madrid a Colmenar Viejo, Finca "Tres Cantos", 3.11.1972, leg. F.D. Calonge (MA-Fungi 4172); 629.- Málaga, Al Sur de Alhamin El Grande, junto a la Carretera de Mijas a Coin, 1.1.1972. leg. V. Demoulin (MA-Fungi 4170); 644.- *Ibidem*, surtout en plage rocailleuse, garrigue (*Rosmarinus*, *Erica*) entre le pins, 1.1.1972, leg. V.Demoulin 4228 (BP 58081); 2438.- *Idem*, ex Herb. Demoulin 4228 (LG 201, slide BCC-MPM 1870); 631.- Huelva, R.B. Doñana, en excremento de tejón, 13.2.1977, leg. S.Castroviejo (MA-Fungi 140); 632.- Huelva, Coto Doñana, Sabinar del Marqués, leg. E. Alvarez y F.D. Calonge (MA-Fungi 297); 679.- Mallorca, Valldemossa, Predio Son Moragues, bosque mixto, *Ampelodesma*, *Erica*, musgo 100-200 m, 9.11.1992, leg. P. González (Siquier 115 G, duplex BCC-MPM 1621); 681.- Mallorca, Carretera Calviá-Puigpunyent, 200-300 m, bosque mixto, 21.11.1992, leg. Tomeu Saez (Siquier 116 G, duplex BCC-MPM 1620); 682.- Albacete, Mesones, Sierra del Calar del Mundo, 950 m, WH 5659, suelo arenoso, junto arroyo, en pinar de *Pinus pinaster*, 10.5.1979, leg. M. Honrubia MHG 1918 (MUB 1771); 685.- *Ibidem*, valle en pinar de *Pinus pinaster*, 25.5.1978, leg. Llimona, Honrubia & Egea MHG 325 (MUB 1761); 683.- Murcia, Bullas, Barranco de los Gavilanes, Canteras de mármol, 900 m, pinares de *Pinus halepensis*, 18.2.1979, leg. J.M. Egea MHG 1711 (MUB 1768); 684.- Almería, Sierra de Filabres, Cruce de bacares, Refugio de Icona, WG 4624, bajo *Populus* sp., con gramíneas, cerca de un arroyo, 31.11.1978, leg. I. Sánchez MHG 328 (MUB 1764); 686.- Jaén, Sierra de Cazorla, 1800 m, WG 08, bajo *Pinus nigra* ssp. *salzmannii*, 3.6.1978, leg. X. Llimona, MHG 322 (MUB 1760); 687.- *Idem*, MHG 324 (MUB 1759); 688.- Girona, Collada de Toses (Ripollès), 16.6.1971, leg. Gabarró (MUB 1754); 689.- Jaén, Pantano Franco de Beas, pinar, 30.10.1986, leg. A. Ortega & A. Gª Buendía (GDAC 24678); 700.- Ibiza, Sant Josep, zona de Ca'n Bellotera, 50-100 m, hábitat tipo Ibiza, 12.11.1993, leg. B. Miquel (Siquier I-9 G, duplex BCC-MPM 1792); 701.- Ibiza, Ses Salines, 0-30 m, pinar arenoso cerca del mar, 14.11.1993, leg. J.L. Siquier I-8 G (duplex BCC-MPM 1791); 702.- Ibiza, Sant Josep, Puig de Ca's Damià, 150-200 m, 14.11.1993, leg. J.L. Siquier (I-7 G, duplex BCC-MPM 1790); 703.- Ibiza, Sant Josep, Es Coscollar, 100 m, hábitat tipo ibiza, 13.11.1993, leg. C. Constantino (Siquier I-6 G, duplex BCC-MPM 1789); 704.- *Idem* (Siquier I-5 G, duplex BCC-MPM 1788); 705.- Ibiza, Puid d'En Francolí, Es Buscatell, 200 m, Hábitat tipo Ibiza, 13.11.1993, leg. J.L. Siquier I-2 G (duplex BCC-MPM 1785); 2447.- Tarragona, Gandesa, Santa Magdalena (Terra Alta), pinar de *Pinus halepensis*, 2.11.1994, leg. J.A. Ramirez (BCC-MPM 1877); 2450.- Lleida, Pla de Cérvoles (Pallars Hussà), pinar, 7.11.1994, leg. J. Vila (BCC-MPM 1880); 2453.- Tarragona, Entre Gandesa i Caseres (Terra Alta), leg. J.A. Ramirez, 24.9.1994 (BCC-MPM 1914); 2489.- Cuenca, Buenache, en *Pinus nigra*, leg. F.D. Calonge (BCC-MPM 1973); 2492.- Jaen, Cañada de la Manzanilla, pinar, 8.11.1986, leg. F. Jimenez (BCC-MPM 1975); 2503.- Girona, Mas Florit (Baix Empordà), bosque *Quercus ruber*, con *Rubus* y *Asparagus*, 20.11.1993, leg. M. Aguasca (BCC-MPM 1765); 2555.- Ibiza, Cruce Carretera de San Josep al aeropuerto y Es Codolá, 80 m, 10.1994, leg. J.L. Siquier I 12G (BCC-MPM 1965). SWEDEN: 482.- Gotland, Gaurmelgarn, SW om Sjansterhaurmar, sandstrand, gláutor med emg tallskog i tallshogsbupret, 3.9.1950, leg. B. Pettersson (UPS); 483.- Gotland, Norrlanda, Hammars i torv där en nyanlagd vag år genom ett kärr, 1.9.1966, leg. G. Eriksson (UPS); 484.- Gotland, Västerhejde sn, Ygne, på lerigt, veg. fritt område, gles bbarrskog, 8.1946, leg. B. Pettersson (UPS); 485.- Gotland, Hörsne sn, c. 4 Km Ö om kyrkan i marken i hedartad tallskog, 6.11.1958, leg. G. Eriksson (UPS); 486.- Vrml, Kristinehamn, utanför kanslihuset på A9, Barbro Palm, 28.9.1983 (UPS); 487.- Uppland, Stockholm, Bromma sn, Traneberg, 20.8. 1922, leg. H. Du Rietz (UPS); 488.- Uppland, Uppsala, Flottscend, 26.8.1905, leg. R.E. Fries (UPS); 490.- Uppland, Upsalia, ex Herb. E. Fries (UPS); 491.- Uppland, Älvkarleö sn, Älvkarleby, 1870, leg. G. Beronius (UPS); 492.- Gotland, Lummelunda sn, Marlebo myr., 9.10.1892, leg. M. Larsson (UPS); 493.- Gotland, Othem sn, 9.1895, leg. H. Lindström (UPS); 494.- Uppland, Tunbo prástgårds skog, 8.1896, leg. E. Nordstron (UPS); 499.- Gotland, Lummelunda sn, Etebols, 23.8.1946, leg. E.Th. Fries (UPS); 527.- Blekinge, Sölvesborg, Stadsskogen, close to the ship-yard, 2.10.1946, leg. S. Lundell & S. Wikland (Fungi Exsiccati Suecici, Præsertim Upsalienses 2257) (C); 537.- Gotland, Martebo myr 9.10.1892, leg. M. Larsson (GB); 583.- Uppland, Skoklsters socken, Arnöhuvud, längs Mälaren, Norra sidan av Arnöhuvud. Ungefär vid "b" i Tyberget. I mineraljord som spolats ner från klippbrant. Här ock Hysterangium, 10.8.1978, leg. E. Plahn (S); 584.- Uppland, Orkesta sn, NV om Stolpekebysjön, nära Lindholmen, 8.9.1950, leg. D. Lundqvist, as *R. luteolus* Fr. (S); 585.- Uppland, Uppsala, Lännersta, 26.5.1872, leg. H. von Post, as *R. luteolus* (S); 586.- Gotland, 9.1896, leg. K.A. Gröuwell, as *R. luteolus* (S); 588.- Gästrikland, Valbo sn, Furuvik, 10.8.1942, leg. R. Nannfeldt (UPS); 589.- Uppland, Gustavisberg sn, Mörtnäs, 8.1887, leg. H. Kugelberg, as *R. albus* (*rufescens*) (UPS); 590.- Uppland, Uppsala, Hort. Bot., in olla tepidarii, 1866, leg. Th.M. Fries (UPS); 591.- Västmanland, Sala, Barnelund, 13.8.1949, leg. R. Morander 1423 (S); 594.- Sala, Tiskarbo, under thuja på naken jord Napot sgulig i jordytan, 19.8.1939, leg. R. Morander (UPS); 595.- Gotland, Högklint, 11.8.1900, leg. R.E. Fries (UPS); 596.- Uppland, Bondkyrka sn, Flottsund, 26.8.1905, leg. R.E. Fries (UPS); 597.- Hälsingland, Njutånger sn, Iggesund, n. sjön, 8.1901, leg. L. Romell (UPS); 598.- Uppland, Össeby-Garns socken, 8.8 Km Ö om Össeby-Garns kyrka, vid Hersbysjön, 300 m V om Hersbysön gård, granskog, dikeskant, delvis blottat ovam jord, 27.9.1975. leg. L. Fernbrink (S); 600.- Södermanland, Torö socken,

Töro Sanding stran, tallskog, 19.10.1986, leg. L. Ödkint (S); 601.- Södermanland, Gåsinge-Dillnás socken, SV om Skeppsta gård den starkt av. surströmming, 3.9.1975, leg. K. Bohlin (S); 602.- Västergötland, Karlsborg, vid det gamla övingsfältet "Heden" SV om fästringen, sandig hed längs landsvägen, gles tallskog, nästan helt exponerade ovan markytan, svagt rodnande, 12.10.1975, leg. L.E. Kers 4521 (S); 603.- Gotland, Norrlanda socken, Hammars, I mosse med Sphagnum, nedskuren c. 8 dm av nyligen lagd skogsväg, I övre delen av den genomskurna delen av marken, svag, behaglig doft, 1.10.1966, leg. G. Eriksson (S); 604.- Bohuslän, Tanums socken, Lindö, södra delen av Lindö, ca. 200 m NNV om Vadkilen, under embuskförna och mossor på den igenvuxna vägen, 28.9.1978, leg. J. Nitare (S); 605.- Uppland, Sollentuna socken, Vidsjön, ravalen södra ände, I katen av. kasselbuskage, I närheten även *Picea* och *Pinus*, 23.7.1979, leg. J. Nitare (S); 606.- Uppland, Djursholm, kvart, Drott i barrmatta, 29.8.1948, leg. G. Berggren (S); 607.- Uppland, Djurö sn, Runmarö, Södersunda, stubbåker, 2.10.1948, leg. R. Rydberg (S), 608.- Without exact loc, 1889, leg. K. Starbäck (S); 612.- Uppland, Alsike sn, 1 km V om Rickebasta, 15.9.1946, leg. O.H. Selling (S); 613.- Uppland, Adelsö socken, Adelsó i Mälaren 200 m NV om gården Nälby, gammal, mossing barrskog, mest gran, under barrförna, 22.8.1977, leg. L.E. Kers 6004 (S); 614.- Uppland, Bondkyrka, Ultuna, 26.7.1892, leg. H. von Prost (S); 615.- Uppland, Uppsala, Kungsparken, 31.7.1896, leg. H. von Prost (S); 622.- Västergötland, Näs, Nolgården, under *Juniperus communis* on calcareous moraine, dry calcareous meadow, 6.9.1987, leg. M. Jeppson (Jeppson 2247); 623.- Gotland, Lummelunda, Kinner *Pinus sylvestris* forest on calcareous soil, 25.6.1979, leg. M. Jeppson (Jeppson 1296); 723.- Uppland, N-justerö, Bossarviken, grädsvik, alldeles nära havstrand bredvid berg i skogen, 59° 32' N/ 18° 41' E, 10.8.1967, leg. P. Alanko 6063:243 (H). SWITZERLAND: 563.- Basel, 18.5.1922, leg. Knapp as *Rhizopogon rubescens* Tul. ex Herb. Soehner 572 (M); 568.- *Ibidem*, 31.1.1921, leg. Knapp, ex Herb. Soehner 393 (M); 697.- *Ibidem*, 15.11.1921, leg. Knapp-Basel (M).UNITED KINGDOM: 496.- England: Lundhurst, Hampshire, 10.1868, leg. C.E. Broome as *Rhizopogon rubescens* Tul. (Klotzschii, Fungi Europaei exsiccati 1279) (PAV); 609.- *Idem* (S); 626.- *Idem* (UPS); 668.- England: Somerset, Cleeve Cliff, under pine, 3.11.1953, ex Herb. Hawker H 958, as *R. rubescens* var. *sulphureus* (K); 669.- *Ibidem*, 22.6.1954, leg. J. Fraymouth, ex Herb. Hawker H 1041, as *R. rubescens* (K); 724.- England, Devonshire, 10.1845 ex Herb. W. Nylander, as *R. rubescens* Tul. (H); 735.- England, Chudleigh, Dion, 10.1845, as *R. rubellus* (G).

Extralimital collections. AFGHANISTAN: 725.- Khenjan, garden of Khenjan Hotel, on lawn, 1 m from the base of pine tree, 1080 m, 13.5.1972, leg. P. Uotila 16621 (H). INDIA: 517.- Arunachal, *Pinus*, 9.9.1981, leg. Sharma, as R. rubescens ss. Cunningham (Groß 838); 670.- Pahalagan, under *Picea* and *Pinus*, erupting through needle duff, 6.10.1978, leg. R. Watling 12967, as *R. luteolus* Fr. (E). CANADA: 611.- Ontario, S of Tottenham Simcoe Co, in sandy soil under needle duff under Jack & red pine, 31.10.1954, leg. R.F. Cain, as *R. roseolus* (Corda) Zeller & Dodge (Cryptogamic Herbarium University of Toronto 31103) (S); 694.- *Idem* (M). UNITED STATES: 447.- Idaho, North Fork of Lake Fork Creek, Payette Lakes, Valley Co., 12.7.1958, leg. A. H. Smith 58778, HOLOTYPE of *R. luteorubescens* A.H. Smith (MICH, slide BCC-MPM 2125); 448.- Idaho, Priest River Experimental Forest, Priest River, Bonner Co., 11.7.1964, leg. A.H. Smith 68322, PARATYPE of *R. luteorubescens* A.H. Smith (UPS); 469.- *Idem* (UPS, slide BCC-MPM 2012); 572.- Colorado, Aspen,Independence Pass, 10.8.1977, leg. A. Bresinsky 77-18 (M); 618.- Nort-Wiscosin, leg. Dodge, as *R. roseum* Bres. (S); 648.- Massachusetts: Arligton heights, North side of reservoir, under *Pinus rigida*, 11.1896, leg. R. Thaxter 4596, as *R. roseolus* (Corda) Zeller & Dodge (PRM 681421); 1059.- California, Shasta Co., Redding, hypogeous under *Pinus* sabiniana-*Quercus-Arctostaphylos*, 30.12.1977, leg. R. Molina, ex Herb. Trappe 5184, as *R. rubescens* (Tul. & Tul.) Tul. & Tul. (Groß 743); 2370.- Idaho, South Fork of Lake Creek, McCall, Valley Co., 12.7.1963, leg. A.H. Smith 65349, HOLOTYPE of *R. pseudoroseolus* A.H. Smith (MICH); 533.- Illegible data (RO); 616.- Illegible loc., 8.1884, leg. Bresadola, as *R. rubescens* Tul. (S); 656.- Without loc., karlstejn, 11.6.1961, leg. E. Wichansky, as *R. virescens* Karst. (PRM 616702); 677.- Without data, leg. Levinsor, as *R.*

rubescens (W 5075); 699.- Without loc., 14.10.1989, as *R. luteorubescens* (Vries 1234); 710.- ? Bab-el-Waad, sous *Pinus halepensis*, 25.2.1952, leg. T. Rayos, as *R. luteolus* Fr. (PC).

D.- Collections with spore volume superior to 52.6 mm^3

European collections. **AUSTRIA**: 1048.- Kärnten bei Villach ex Herb. Beck, as *R. rubescens* Tul. (PRM); 1080.- Gnadenwald, Tirol, unweit Guggl, unter Pinus an Wegrand, 25.6.1983, leg. M. Moser, as *R. rubescens* (Tul.) Tul. (IB); 1088.- St. Egyden, N.Ö., *Pinus nigra* f. *austriaca*, 30.5.1987, leg. Ann & Kurt Mader (BCC-MPM 1515); 1089.- Natschenhach bei Seebenstein N.Ö, *Pinus sylvestris*, 30.5.1987, leg. Ann & Kurt Mader (BCC-MPM 1513); 1091.- Schuechergdörfl, N.Ö, Mischwald, 7.9.1980, leg. Ann et Kurt Mader (BCC-MPM 1514); 1095.- Brünn, Hähuem, 8.1882, leg. Nießl ex Herb. Nießl, as *R. rubescens* Tul. (M); 1096.- Milterndorf in Steiermark, Fichtenwald, leg. Nießl, as *R. rubescens* Tul. (M); 1099.- M-Weisskirchen, unter Föhren, 6.1925, leg. F. Petrak, as *R. rubescens* Tul. (M); 1154.- Tirol, 13.8.1909, leg. P. Magnus, as *R. rubescens* Tul. (HBG); 1202.- Nieder-Österreich, in einem Schwarzföhren-walde oberhalb, 8.1897, leg. D.A. Zahlbuckner, as R. rubescens Tul. (W 5015). **BELGIUM**: 1053.- Namur, Oignies-en Chiérache, 350 m, sous *Pinus sylvestris*, 22.9.1979, ex Herb. Marchal 79/070 (LG, slide BCC-MPM 1420); 1054.- Luxembourg, Soy, Biron, plantation de *Pinus sylvestris* dans un molinietum sur schiste calcaire, 25.9.1966, leg. Havrenne, ex Herb. Demoulin 3484 (LG, slide BCC-MPM 1422); 1055.- Namur, Dourbes, Tiène pelé, IFB J% 41221, a terre en sentier herbeux sous pinus nigra en compagnie de *Clitopilus prunulus*, 20.10.1978, leg. A. Marchal (LG, slide BCC-MPM 1421); 1195.- Bois de Resteigne (Ard.), under *Corylus avellana*, 24.9.1974, leg. G.A. de Vries (Vries 627); 1196.- Bois de Roptai, Ave, Ard., under *Pinus sylvestris*, 11.9.1975, leg. G.A. de Vries (Vries 678). **CZECH REPUBLIC**: 818.- Ces Shedohorí, inter Smolnice et Brloh pr. Loung, ad terram in piceto, 15.7.1955, leg. F. Kotlaba (PRM 742566); 1049.- Bohemia occid., pagus Zdár u Rokycan, in via sylvatica, 10.7.1935, leg. K. Cejp (PRM); 1083.- Prencow, Stankojo vršok, 23.9.1897, leg. A. Kmet, as *R. rubescens* Tul. (LD); 1093.- Namiests in Mähren, leg. Nießl von Mayerndorf ex Herb. H. Wilms (M); 1191.- Kopecek pr. Olomouc, in silva conif., 2.6.1965, leg. L. Rychtera (PRM 604239), as *R. roseolus* v. *intermedius* Svr. (Flora moravica); 1193.- Mohelno, 30.10.1931, leg.Dvorak, TYPE of *R. mohelnensis* Vel. (PRM 154616); 1194.- Mnichovice, inter verrimenta, 6.1934, leg. Velenovský, TYPE of *R. duriusculus* Vel. (PRM 154791, slide BCC-MPM 2182); 1204.- Mähren, bei Nepomuk (Iglau), im Waldboden halbunterirdisch, 15.9.1935, leg. Canon, as *R. rubescens* Tul. (W 15130); 1190.- # Bohemia centr., Jardv pr. Zlraslav, in querceto (cum *Picea*), 23.5.1954, leg. K. Ponez (PRM 619003); 1192.- # Roblín (Bohemia), in silva acerosa (*Picea excelsa*, *Pinus sylvestris*), 13.11.1946, leg. V. Vacek, as *R. aestivus* Wulf. (PRM 618976). **ESTONIA**: 1220.- Saaremaa, Viidumäe, ad terram, 26.6.1974, leg. E. Parmasto, as *R. rubecens* (Tul.) var. *rubescens* A.H. Smith (TAA 63122). **FINLAND**: 1167.- Regio aboënsis, Taivassalo commune, Sarsalankylä, Grid 27°E 6371:208, 19.9.1965, leg. E. Johnsson (TUR); 1169.- Regio aboënsis, Turku, Hirvensalo, forest of *Pinus sylvestris* and Quercus robur, Grid 27°E: 6710: 236, 1985, leg. M. Kiviluoto (TUR); 1170.- Regio aboënsis, Turku commune, Metsäkylä, under *Pinus sylvestris*, Grid 27°E: 6716:237, 24.9.1949, leg. L.E. Kari (TUR); 1171.- Regio aboënsis, Kaurikumpu 8, in mull under *Pinus sylvestris*, 60°30'N 22°8'E, 17.9.1973, leg. A. Sarjala (TUR); 1213.- Tavastia australis, Tampere, Pyynikki, lawn, near pine trees, Grid 682:32, 25.9.1976, leg. W. Jakowlev (OULU); 1214.- Karelia australis, Virolahti, Eerikkälä, Poroniemi, washed on (sea) shore, Grid 6708:537, 20.10.1983, leg. T. Rintanen (OULU); 1215.- Tavastia australis, Tampere, Alasjärvi, bank at margin of mixed forest, nearest trees willow, birch, alder spruce (at a distance of 5 m), pine (at a distance of about 8 m), Grid 6826:334, 17.7.1976, leg. W. Jakowlev & U. Söderholm 152 (OULU); 1238.-Regio aboënsis, V. Rymättylä, Suutarla, MT, metsäpolun reunassa, 30.7.1979, leg. R. Tuomikoski (H); 1239.- Ostrobottnia australis, Kurikka, Myllykylä, Vesiperä, on the small islet in the old limestone quarry filled with water, Pinus sylvestris and Alnus incana, Grid 27° E 6946:267, UTM EQ 4, 15.9.1982, leg. I. Kytövuori 82344, as *R. rubescens* Tul. (H); 1240.- Savonia australis, Imatra, inv. Idrottsplan, Tallskogsdunge på marken, 9.9.1951, leg. A.

Rauhala (H); 1241.- *Ibidem*, inv. Hjältegraven, Tallskogsdunge på marken, 13.9.1951, leg. A. Rauhala (H); 1242.- Regio aboënsis, Raisio Metsäkylä metsätien laita, männynjuurilla, 24.9.1949, leg. H. Såltin as *Scleroderma aurantium* Pers. (H); 1243.- Nylandia, Borgå, Näsebacken vid Kyrkogården, 9.1919, leg. W. Nyberg, as *R. rubescens* Tul. (H); 1244.- *Ibidem*, withouth date, leg. Wolmar Nyberg (H); 1245.- *Ibidem*, Vessö, barrskog, UTM MG 1, 16.8.1937, leg. W. Nyberg (H); 1248.- *Ibidem*, 9.1920, leg. W. Nyberg (H); 1246.- Nylandia, Grankulla, väg nära tall, grid 27°E 667-68:37, UTM LG 1, 22.8.1948, leg. W. Nyberg, ass *R. rubescens* Tul. (H); 1247.- Nylandia, Inkoo, Fagervik, 22.7.1963, leg. O. von Schulmann (H). FRANCE: 1047.- Région littorale et montagneuse, bois de la "Mairis" "Drap" "Nice", Automne 1885, leg. J.B. Barla as *Rhizopogon provincialis* Tul (Roumeguère, Fungi Gallici exsiccati 3826) (PAV); 1076.- *Idem* (DBN); 1163.- *Idem* (UPS); 1189.- *Idem* (G); 1237.- *Idem* (PC); 1052.- Landes, dunes au N de Mimizan-Plage, forêt de Sainte-Eulalie, sous *Pinus maritima* avec *R. luteolus* et *R. vulgaris*, 25.10.1968, leg. V. Demoulin (LG, slide BCC-MPM 1431); 1056.- Vauclause, Mt. Ventoux, 7-800 m NW from the Pavillon Fr. de Rolland, 6 km E from Bédom, 800 m, UTM FJ 8088 44° 6N, 5° 1E, under *Cedrus atlantica* (introduced) with *Quercus ilex* and *Q. pubescens* on limestone, 21.10.1974, ex Herb. Demoulin 4862 (LG, BCC-MPM 1433); 1077.- Alpes, Isère, Greoble S, Parc Nationale Vercors, Gresse-en Vercors, 44° 54' N, 5° 34' E, 1250 m, 13.10.1990, leg. Groupe Mycologique, as *R. luteolus* Fr. et Nordh. (BUCM 117879); 1081.- Drap, mont. de Brando, Alp. Marit., régions littorales et montagneuses, Automne 1886, leg. J.B. Barla, as *R. provincialis* Tul. (C); 1156.- Troyes, in pinetis, 7.1882, leg. Boudier, as *R. briardi* (S); 1177.- Environs de Troyes, Aube, 7.1885, leg. Briardi as *Rhizopogon briardi* Boudier (Roumeguére, Fungi Gallici exsiccati 3661) (BP 22288); 1178.- *Idem* (K); 1189.- *Idem* (G); 1183.- Nice, 6.1883, leg. M. Barla, as *R. rubescens* (PC); 1184.- *Ibidem*, 19.7.1891, leg. Barla (PC); 1185.- *Ibidem*, 3.1885, leg. M. Barla (PC); 1209.- Montpellier, 8.1901 ex Herb. Boudier, as *R. rubescens* (PC). GERMANY: 1060.- Württermberg, Tübingen, unter *Pinus*, Kalk, 30.9.1977, leg. Kautt, as *R. rubescens* var. *rubescens* ss A.H. Smith (Groß 618); 1062.- Karlstadt, Bayern, 4.10.1980, leg. Hintz (Groß 697); 1098.- Schwenningen, 21.6.1949, leg. H. Haas ex Herb. Soehner 2246, as *R. rubescens* Tul. (M); 1100.- Budenheim, in pinetis, raro Autumno as *R. rubescens* Tul. (Fuckel, Fungi rhenani 1251) (M); 1102.- Dürrenast-Heide, Waldkiefer, 2.11.1969, leg. Stangl, as *R. rubescens* Tul. (Groß 351); 1103.- Eimersdorf, Saar, Fichte-Schwarzkiefer, Muschelkalk, 22.6.1968, leg. J. Schmitt ex Herb. Groß 149 (M); 1108.- *Ibidem*, 28.9.1968, leg. Gross 225 (M).1147.- *Idem*, leg. Groß 156 (M); 1104.- Ettersberg i Vagtl, 15.5.1950, leg. A. John, ex Herb. Soehner 2261, as *R. rubescens* Tul. (M); 1105.- Stuttgart-Dagerloh, 8.9.1953, leg. H. Haas, ex Herb. Soehner 2373, as *R. rubescens* Tul. (M); 1106.- Günzkofen bei Mühldorf, 25.7.1924, ex Herb. Soehner 860, as *R. rubescens* Tul. (M); 1107.- Erharting bei Mühldorf, Fi-Wald, 8.1921, leg. Soehner 537 (M); 1111.- *Ibidem*, unter Fichten, 5.8.1923, ex Herb. Soehner 763 (M); 1113.- *Ibidem*, Lehmboden in einem Bodenhaufen, ex Herb. Soehner 669 (M); 1109.- Brandenburg, Friedersdorfer, Forst bei Alt-Stahnsdorf, Kiefernwald, 22.7.1938, leg. T. Weiß, ex Herb. Soehner, as *R. rubescens* Tul. 1563 (M); 1110.- [Bayern, Niederbayern, N of Mühldorf a Inn], Erhating, Fichtemwald, 19.7.1922, ex Herb. Soehner 611, as *R. rubescens* (M); 1112.- Pleifskirchen bei Mühldorf, Fi-W, 5.8.1922, ex Herb. Soehner 644 (M); 1114.- Unterfranken, Karlstadt, Kieferwald Karst, unterer Muschekalk, MTB 6024, 4.10.1980, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 1115.- Unterfranken, Gemünden, Lerchenberg, Karst, unterer Muschelkalk, *Pinus*, *Fagus*, MTB 5924, 11.6.1983, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 1116.- Unterfranken, Karlstadt, Mäusberg Karst, unterer Muschelkalk, *Corylus*, *Pinus*, MTB 6024, 27.11.1982, leg. R.A. Hintz, as *R. luteorubescens* (M); 1136.- *Idem*, as *R. rubescens* var. *rubescens* (M); 1145.- *Ibidem*, unterer Muschelkalk, *Quercus*, *Pinus*?, 27.11.1982, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 1117.- Wertheim, Lindelbach, MTB 6223, 27.6.1981, leg. R.A. Hinzt (M); 1144.- *Idem*, as *R. luteolus* Fr. & Nordh. (M); 1118.- Unterfranken, Karlstadt, Sperbühl Karst, unterer Muschelkalk, MTB 6024, 29.9.1984, leg. R.A. Hintz (M); 1134.- *Idem*, as *R. rubescens* var. *rubescens* A.H. Smith (M); 1119.- Unterfranken, Karlstadt, Arnstein, Klößburg, Affental, *Corylus*, MTB 6024, 13.11.1982, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith (M); 1120.- Unterfranken, Gemünden, Uhlberg Karst, unterer Muschelkalk, *Fagus*, *Pinus*, *Sorbus*, MTB 5924, 17.6.1983, leg. R.A. Hintz, as *R. luteorubescens* A.H. Smith. (M); 1121.- München, in Waldfriedhof, 1.6.1920 ex Herb. Soehner 541920, as *R. provincialis* Tul. (M); 1123.- Vilseck under Eichen, 5.9.1919, leg. Killermann ex Herb. Soehner 1213, as *Hysterangium coriaceum* Hesse (M); 1124.- Unterfranken, Gemünden Dielsloch, Karst, unterer Muschelkalk, 22.8.1982, leg. R.A. Hintz, as *R. rubescens* var. *rubescens* (M); 1126.- *Idem*, 11.9.1982 (M); 1125.- Würzburg, unter einer Buche in einem Graben, 1.8.1923 ex Herb. Soehner 752 (M); 1127.- Unterfranken, Karlstadt, Erlen-B, Karst, unterer Muschelkalk, 100 m E' Waldrand, 29.5.1983, leg. R.A. Hintz, as *R. rubescens* var. *rubescens* A.H. Smith (M); 1128.- München, 1.1924, leg. E. Soehner, as *R. rubescens* Tul. (M); 1129.- Regensburg, Hauzenstein, Kief-Wald, 27.8.1913, leg. S. Killermann, as *R. rubescens* (M); 1130.- Oberbayern, an der Strasse von der Wolfratshausener Brïdre nach Ascholding, 6.6.1943, leg. Süssenguth, as *R. rubescens* Tul. (M); 1132.- Isaraven bei Wolfratschausen, 8.1919, leg. Soehner 1355, as *R. rubescens* Tul. (M); 1133.- Laüffen bei Rottweil auf sandifem Waldweg, 3.9.1950, leg. Haas, ex Herb. Soehner 2273, as *R. occidentalis* Zeller & Dodge (M); 1135.- Heimenegg, Mindelheim, Fi-W, 20.9.2946, ex Herb. Soehner 2162, as *R. rubescens* Tul. (M); 1137.- Aus Ungebg-Regensburg, Karlstein, 9.1924 (M); 1139.- *Idem* (M); 1138.- Unterfranken, Gemünden, Dids Lock, Karst, unterer Muschelkalk, MTB 5924, 22.8.1982, leg. R.A. Hintz, as *R. rubescens* var. *rubescens* A.H. Smith (M); 1140.- Windsbach, Moosbach, in Föhren wäldchen, near Ansbach, 19.5.1920 (M.); 1141.- *Ibidem* (M); 1142.- München-Hohenrain, Fi-W., 27.6.1944, ex Herb. Soehner 1977, as *R. rubescens* (M); 1143.- Haar, Fichten unter Moos, 29.10.1944, ex Herb. Soehner 2104, as *R. rubescens* (M); 1150.- Darmstadt, 1909, leg. W. Völsing, as *R. aestivus* (Wolf.) Fr. (HBG); 1221.- Glatz, Schlettau, 2.10.1943 ex Herb. Soehner 1962 (M); 1222.- Reichenburg bei Wünzburg, Büchenwald, 31.7.1923 (M 748); 1223.- Lindacher Forst bei Hohenlinden, Eich-Wald under Fichten, 12.6.1920 (M 971920); 1227.- Gerolstein, Monterley, sub Pino et Crataego, 24.9.1980, leg. G.A. de Vries, as *R. vulgaris* (Vries 780); 1235.- Jena, NSG Leutratal SW Jena, Westteil des NSG, Halbtrockenrasen, 4.9.1985, leg. W. Heinrich (JE); 1236.- Eisenach, Büchenan bei Wünzburg, Salix, Betula, 5.1987, leg. Grögel, as *R. vulgaris* (JE); 1092.- # Taschental bei Katzelsdorf, 400 m, Fichten-Wald, leg. P.S. Hans ex Herb. Soehner 1990 (M). **ITALY**: 1031.- Tirolo meridionale, nelle selve montane presso Bolzano, 1865, leg. Hausmann as *R. rubescens* (Erbar. Crittogam. Ital. Ser. II 42) (SIENA); 1043.- *Idem* 1031 (PAV); 1085.- *Idem* 1031 (RO); 1187.- *Idem* (G); 1057.- Firenze, boschi di Vincigliata, 6.4.1916, leg. E. Pampanini, as *R. provincialis* Tul. (FI); 1061.- Völs, Südtirol, auf Kalk im Gebirge, 8.1979, leg. Knocj, as *R. marchii* (Bres.) Zeller & Dodge (Groß 663); 1086.- Cosenza, La Sila, bosco puro di *Pinus laricium*, terreno acido, 1100 m, 27.10.1984, leg. C. Lavorato 841027-21 (duplex BCC-MPM 1505); 1087.- *Idem*, 1200 m, leg. Lavorato 851114-24 (duplex BCC-MPM 1506); 1152.- Tirol, S. Vigil, 8.1894, leg. M. Günke ex Herb. P. Magnus, as *R. aestivus* (HBG); 1153.- *Ibidem*, 1200 m, 16.8.1894, leg. M. Günke ex Herb. P. Magnus, as *R. rubescens* Tul. (HBG); 2439.- Febbio (Reggio E), b/ Pinus nigra, 900 m, leg. A. Montecchi 539 (duplex BCC-MPM 1524); 2519.- Bornio (SO), Le Motte, abeti-larici, 1200 m, 26.9.1992, leg. M. Sarasini (Sarasini 448); 2520.- Taggia (SM), macchia con timo, 300 m, 24.5.1994, leg. M. Rizzoto (Sarasini 566); 2521.- Fondo (TN), Vicino Hotel Lady Maria, aiola con pino, 900 m, 17.9.1994, leg. M. Sarasini (Sarasini 612); 1094.- # Montevaccino, in pinety, 19.9.1924, leg. Rensi, ex Herb. Bresadola 1806, as *R. rubescens* Tul. (M). **NORWAY**: 1073.- Opland, Vågå, Prestberget, 600 m, NP 0360, 18.8.1984, leg. W. Postma (TRH); 1075.- Sör-Tröndelag, Oppdal, 19.8.1978, leg. A. Skaslien (TRH). **POLAND**: 1078.- Kampinoski Park Narodowy, Truskaw (woj. Warszawskie), ad arenosos apricosque ad pineti marginem, 20.9.1960, leg. W. Rudnicka-Jezierska, as *R. luteolus* Fr. et Nord emend Tul. (Plantae Varsavienses exsiccatae 24) (C); 1216.- *Idem* (OULU). **ROMANIA**: 1079.- Brasov, Mt. Postavarul, sub. *Pinus cembra*, 14.8.1964, leg. László K. & Babosné M., as *R. aestivus* Fr. (C); 1175.- *Idem* (BP 42112). **RUSSIA**: 1249.- Rossia, Siberia, Yakutsk, Lena inferior, Önkyr-yra, unter Moos in Lärchenwald, 1901, leg. A.K. Cajander, ex Herb. Karsten 3703, as *R. luteolus* Fr.

(H). **SPAIN**: 1025.- Teruel, Albarracín, bajo pino y encina, 27.10.1988, leg. F.D. Calonge (BCC-MPM 1700); 1026.- Barcelona, Pantà de Foix, Foix (Garraf), 100-200 m, CF 86, pinar, 5.11.1983, leg. X. Llimona (BCC-MPM 336); 1027.- Girona, La Farga de Bebié, Les Lloses (Ripollès), 950 m, DG 36, margen de hayedo con *Picea*, entre musgos, 17.10.1985, leg. J.M. Mestres (BCC-MPM 464); 1028.- Teruel, Penyarroya, bajo *Pinus sylvestris*, 30.5.1992, leg. A. Rocabruna (BCC-MPM 1546); 1029.- *Idem* (BCC-MPM 1651); 1030.- Mallorca, Serra d'En Merill, 50-100 m, *Pinus halepensis*, *Arbutus undeo*, *Pistacia lentiscus*, *Cistus albidus*, *Cistus monspeliensis*, *Erica multiflora*, 20.5.1993, leg. J. Siquier (BCC-MPM 1671); 1051.- Málaga, au N d'Ojén sur la route de Coín, 500 m, maquis sur roche cristalline (*Lavandula*, *Cistus monspeliensis*), avec *Pinus* pinaster et *P. halepensis*, 31.12.1971, ex Herb. Demoulin 4222 (LG, slide BCC-MPM 1430); 1074.- Cazorla, pinar, 10.1992, leg. pastores (BCC-MPM 1491); 1090.- Mallorca, Banyalbufar, Predio Son Bunyola, 400-500 m, 18.11.1991, leg. J.L. Siquier 116 G (duplex BCC-MPM 1511); 1172.- Burgos, Aranda de Duero, en encinar, 16.4.1985, leg. F. Lamata (MA-Fungi 2995); 1173.- Granada, Los Cachorros, Monachil, en pinar, 24.9.1979, leg. R. Galán (MA-Fungi 1753); 1205.- Mallorca, Escorca, Predio Manut, bosque mixto con *Quercus ilex* y *Pinus halepensis*, con *Pistacia*, *Ampelodesma* y *Mirtilus*, 700-800 m, 9.1.1993, leg. J.L. Siquier 123 G (duplex BCC-MPM 1615); 1206.- Murcia, Cartagena, Parque de Tentegorra, pinar de *Pinus halepensis* de repoblación, XG 7765, 6.11.1977, leg. M.A. Martínez, ex Herb. Honrubia MHG 451 (MUB 1763); 1207.- Lleida, Vall Ferrera (Alt Urgell), Besos de Alins, 1.6.1971, leg. Menal (MUB 1755); 1208.- Albacete, Campamento Riopar, 11.1980 ex Herb. Honrubia 3369 (MUB 1756); 1232.- Asturias, Pruneda, Cabranes, *Pinus radiata*, suelo compacto y arcilloso, pH 4.2, 8.12.1985, leg. C. Colinas A-8 (MA-Fungi 28337); 1233.- *Ibidem*, *Pinus radicata*, 350 m, 12.5.1986, leg. J. Trappe A-10 (MA-Fungi 28338); 1234.- Mallorca, Serra d'En Merill, *Pinus halepensis*, *Arbutus unedo*, *Pistacia lentiscus*, *Cistus albidus*, *Cistus monspeliensis*, *Erica multiflora*, 50-100 m, 16.5.1993, leg. J.L. Siquier 126 G (BCC-MPM 1671); 2440.- Teruel, Manzanera, Sierra de Javalambre, 1400 m, pinar y sabinar, 21.5.1994, leg. *R.* Montull (BCC-MPM 1859); 2448.- Girona, La Farga de Bebié (Ripollès), encinar con pinos, en un talud, 4.11.1994, leg. L. Chamorro (BCC-MPM 1878); 2452.- Lleida, Guils de Cerdanya (Alt Urgell), b/ *Juniperus communis* en bosque de *Pinus sylvestris*, 1400 m (BCC-MPM 1898); 2554.- Ibiza, Carretera a Sant Josep Km 4, bosque de *Pinus halepensis* con *Pistacia* y *Cistus*, 17.11.1994, leg. J.L. Siquier I-136 (BCC-MPM 1964); 2556.- *Idem*, leg. J.L. Siquier I-15 (BCC-MPM 1966). **SWEDEN**: 1033.- Gotland, Läbrö, NÖ om Takstens, på Ancylusvallen, sandigt i barrskog, vidväg, 16.10.1957, leg. B. Pettersson 6850 (UPS, slide BCC-MPM 2050); 1034.- Närke, Hallsberg par., Oversta, Källtorp, on soil surface in coniferous wood, 18.6.1972, leg. S. Ryman 469 (UPS); 1035.- Småland, Jönköping, Ljungarumsskogen, ej långt från Simsholmen, 1887, leg. G. v. Porat (UPS); 1036.- Gotland, Bro sn, Stenstu, 18.9.1950, leg. E.Th. Fries (UPS); 1037.- Gotland, Othem sn, Othemars, 13.6.1946, leg. G. Haglund 1227 (UPS); 1038.- Uppland, Lena sn, Årby skog, utmed sandig väg i barrskog, 21.8.1941, leg. S. Lundell (UPS); 1039.- Uppland, Funbo sn, Storudden, löst liggande bland gräs på grusväg i närheten av *Amanita rubescens*, 15.8.1971, leg. E. Åberg (UPS); 1040.- Södermanland, Björkvik sn, prästgårdsskogen, 10.1933, leg. Thyra Henschen (UPS); 1041.- Uppland, Bondkyrka par., Nåsten S of Håge in soil surface under *Pinus sylvestris*, 5.9.1969, leg. S. Ryman (UPS); 1042.- Uppland, Uppsala, Graneberg, 7/8.1988, leg. E.A, K.R. Hj. & Th. Fries (UPS, slide BCC-MPM 2045); 1044.- Västmanland, Sala, Gamla Broddbovägen, S om Kusbo, 30.6.1946, leg. R. Morander 642 (UPS); 1045.- Uppland, Gamla Uppsala, Björkby, 9.1882, leg. C.E.J. Ek (UPS); 1082.- Uppland, Uppsala, Flottsund, 7.1903, leg. Th.C.E. Fries (LD); 1155.- Uppland, Värmdö, Vik, 7.1891, leg. H. Kugelberg, as *R. luteolus* Fr. (S); 1157.- Jämtland, Östersund, 8.1905, leg. E.A. Fries (UPS); 1158.- Jämtland, Frösö sn, Östberget, östra sluttningen, 8.1885, leg. A.G. Andersson (UPS); 1159.- Uppland, Bondkyrka sn, Kvarnbo lund invid stig under hassel, 11.7.1948, leg. R, Morander (UPS); 1160.- Västmanland, Björksta sn, Näs soldattorp, 13.9.1887, leg. Gust Andersson (UPS); 1161.- Gotland, Hörsne sn, Smissäng, 21.9.1965, leg. Gunnar Eriksson (UPS); 1162.- Östergötland, Söderköping, 22.10.1882, leg. J.M. Blomberg (UPS);

1164.- Uppland, Djurö sn, Runmarö, 1 Km S om Uppeby, på en barrskogsstig, 14.9.1949, leg. G. Haglund, as R. rubescens (S); 1165.- Uppland, Djurö sn, Runmarö, vid vägen mellan Södersunda och Söderby, 16.10.1949, leg. G. Haglund & R. Rydberg, as *R. rubescens* Tul. (UPS); 1166.- Uppland, Torsui socken (Enköpings kommur), ön Röllingen, vid fiskarstugan på östra delen av ön, I skogsbrynet utanför tomten, gles gräsvegetation vid täta granar, 23.9.1974, leg. L.E. Kers 4183 (S); 1168.- Småland, Jönköping, 1887, leg.C. von Porat, as *R. rubescens* (TUR); 1197.- Farkinns-berget, 22.7.1950, leg. L.E. Hawker ex Herb. Hawker H 139 (K); 1198.- Odensala, 22.7.1950, leg. M. Lange ex Herb. Hawker H 135 (K); 1212.- Jämtland, Östersund, Storsjön, Andersön, coniferous forest, on path, 63°10'N,14°26'E, 12.8.1982, leg. V. Hakulinen (OULU); 1217.- *Ibidem*, coniferous forest (*Pinus*, *Picea*), pathside, 63°10°N, 14°26'E, 12.8.1982, leg. T. Ulvinen (OULU). **SWITZERLAND**: 1122.- Jura, Schwalbach, 20.5.1926, leg. S. Killermann, as *R. rubescens* (M); 1131.- Münsingers, 5.1920, leg. H. Münzinger, ex Herb. Soehner 681920, as *R. rubescens* Tul. (M); 1146.- Jura, Laaber, Kiefernwald, 27.7.1919, leg. S. Killermann, as *R. rubescens* Tul. (M). **UNITED KINGDOM**: 1050.- England, Lundhurst, Hampshire, 10.1868, leg. C.E. Broome, as *R. rubescens* Tul. (Fungi hypogaei 1279) (W). [Rev. Svrček as *R. roseolus* vr. *foetens* Svr.]; 1097.- *Idem* (M); 1148.- *Idem* (HBG); 1149.- *Idem* (HBG); 1151.- *Idem* (HBG); 1176.- *Idem* (BP 22315); 1186.- *Idem* (G); 1203.- *Idem* (W 2639); 1228.- *Idem* (CUP); 1251.- *Idem* (W); 1064.- England, Lyndhurst, 10.1868, as *R. rubescens* (E); 1065.- Scotland, Culbin Sands, under *Pinus nigra*, 8.9.1975, leg R. Watling 1138 (E); 1066.- Scotland, Royal Botanic Garden., block 6, growing in pot with *Pinus canariensis* 73:1244 Page 8816, 5.1979, leg. R. Watling 13343 (E); 1067.- *Idem*, ex Herb. Watling 13222 (E); 1068.- *Ibidem* 1066, 5.1980, leg. R. Watling 13570 (E); 1069.- *Idem*, ex Herb. Watling 13572 (E.); 1070.- *Ibidem*, in pot of *Pinus leiophylla* 751226, 15.9.1981, leg. R. Watling (E); 1071.- Irland, Bush Estate, under *Pinus contorta*, 10.1975, leg. J.M. Warcup ex Herb. Watling 11689, as R. luteolus (E); 1072.- *Idem*, ex Herb. Watling 11690 (E); 1179.- England, Somerset, Cleeve Cliff, Goblin Coombe, 1.11.1949, leg. L.E. Hawker H 36 (K); 1199.- *Ibidem*, 10.8.1954, leg. L.E. Hawker H 1057 (K); 1200.- *Ibidem*, 3.11.1953, leg. L.E. Hawker H 957 (K); 1201.- *Ibidem*, under pine, 25.11.1953, leg. J. Fraymouth 308, ex Herb. Hawker H 984 (K); 1180.- *Ibidem*, 9.10.1951, leg. L.E. Hawker H 532 (K); 1181.- *Ibidem*, 14.10.1952, leg. L.E. Hawker H 691 (K); 1229.- *Ibidem*, under pine, 10.6.1955, leg. J. Fraymouth 360, ex Herb. Hawker H 1143, as *R. rubescens* (K); 1230.- *Ibidem*, 25.9.1954, leg. R. Goofrey, ex Herb. Hawker H 1081 (K); 1231.- *Ibidem*, under pine, 12.10.1954, leg. L.E. Hawker H 1100 (K); 1210.- England, Chudleigh, ex Herb. Berk., ex Herb. Montagne, as *R. rubescens* Tul. (=*Melanogaster berkelianus* Broome) (PC); 1182.- # England, Ainsdale Hills, Ainsdale, Lancs, scattered in young *Pinus nigra* plantation on surface of sand beneath mosses and lichens, 20.11.1957, leg. J.T. Palmer 967 (K).

Extralimital collections. CANADA:1024.- Ontario, S of Tottenham, Simece Co., in sandy soil under needle duff, under Jack & red Pine, 3.10.1954, leg. R.F. Cain, as *R. roseolus* (Corda) Zeller & Dodge (UPS, slide BCC-MPM 2026). UNITED STATES:1250.- Takoma Park, Md., 11.1900, leg. C.L. Shear, as *R. rubescens* Tul. (Ellis & Everhart's Fungi Columbiani Continued 1413) (H).

Unknown locality. 1046.- Without data, Coll. M.A. Curtis, Distrib. W.G. Farlow (STR); 1063.- # Holme Hill Plantation, ex Herb. C.E. Broome, ex Herb. Musei Britannici (E); 1084.- ? Dromshine, leg. Berkeley (RO); 1174.- Without data, as *R. aestivus* Fr. (BP 22.304); 1211.- Withouth data, ex Herb. Montagne, as *R. virens* Fr. (PC).

E.- Collections with abnormal spores

European collections. **FRANCE**: 790.- Masif Central, Haute-Loire, Sainte-Sigolène N, Le Villard in Abietum, 800 m, 11.10.1990, leg. G. Negrean, as *R. luteolus* Fr. (BUCM 117766). **CZECH REPUBLIC**: 795.- Namiest, leg. Nießl, as *R. rubescens* Tul. (JE). **GERMANY**: 786.- Schwaningen (WH), Fiechteur, 21.6.1949, leg. H. Haas, TYPE of *R. hymenogastrosporus* Soehner (M). **SPAIN**: 794.- Teruel: Beseit, *Pinus sylvestris*, 1100 m, 12.9.1987, leg. C. Calvet, as *R. ventricisporus* A.H. Smith (MA-Fungi 28352). **SWEDEN**: 789.- Gotland, Ekeby sn, Mangsarus, på brandfläck efter lövränning, 23.6.1966, leg. G. Eriksson (UPS, slide BCC-MPM 2049); 791.- Norrbotten, Junosvando sn, kyrkbyn, i södra utkanten ca. 400 m S. om vägen Junosvando-Vittangi, lerig skogsväg, 17.6.1964, leg. O. Lönnquost (UPS, slides BCC-MPM 2137, 2138 and 2139); 792.- Uppland, Uppsala, Bondkyrka, Fristaden, 24.8.1888, leg. Th.M. Fries, as *R. roseolus* f. *aberrans* Th.M. Fr. (UPS); 793.- Uppland, Fristaden, 24.8.1888, leg. E.A. Fries, as *R. roseolus* f. *aberrans* Th.M. Fr. (UPS).

Extralimital collections. TUNISIA: 2363.- Tabarka, b/*Pinus pinaster*, 12.12.1982, leg. Pacioni, HOLOTYPE of *R. gigasporus* Pacioni (AQUI). UNITED STATES: 788.- Oregon, Linn. Co, Santian Pass, hypogeous under *Tsuga metensiana*, 4820 ft., 24.9.1976, leg. R. Molina ex Herb. Trappe 4724, as R. vulgaris (Vitt.) M. Lange (LG, slide BCC-MPM 1417); 2372.- Idaho,Heaven's Gate Ridge, Seven Devils Mts., Idaho Co., 11.8.1964, leg. H. Burdsall, ex Herb. Smith 69165, HOLOTYPE of *R.ventricisporus* A.H. Smith (MICH).

Rhizopogon subalpinus A.H. Smith

European collections. **SWEDEN**: 975.- Bohusland, Orust, Mörlanda i skogend, 4.9.1887, leg.P. Larsson (UPS, slide BCC-MPM 2153); 978.- Gotland, Visby, 8-9.1893 (UPS, slide BCC-MPM 2051 and 2052); 977*.- # Gotland, Vesterheide, 6.9.1903, as *R. luteolus* Fr. (UPS, slide BCC-MPM 2220).

Extralimital collections. UNITED STATES: 2374.- Oregon, Breitenbusch Hot Springs, marion Co., on the ground near cabins, 8.7.1963, leg. R. Oswald 3, HOLOTYPE (MICH).

Rhizopogon subolivascens A.H. Smith

European collections. **BELGIUM**: 979.- Ardennes, under *Pinus nigra*, 28.9.1968, leg. G.A. de Vries (Vries 893, slide BCC-MPM 2188).

Extralimital collections: 2313.- Idaho, Brundage Mt., McCall, Valley Co., under conifers, 9.7.1962, leg. A.H. Smith 65273, HOLOTYPE (MICH).

Rhizopogon subsalmonius A.H. Smith

European collections. **SPAIN**: 980.- Girona: Pasado Santa Pellaia, dirección Sant Sadurní de l'Heura (Baix Empordà), bajo *Pinus pinaster*, 26.5.1993, leg. A. Sanchez, J. Llistosella & M.P.M. (BCC-MPM 1652); 1498.- Girona: Pasado Santa Pellaia, dirección Sant Sadurní de l'Heura (Baix Empordà), to 1 Km of the locality of collection 980, under *Pinus pinaster*, 26.5.1993, leg. J. Llistosella, M.P.M., A. Sánchez (BCC-MPM 1653); 1499.- *Idem* 1498 (BCC-MPM 1654).

Extralimital collections. UNITED STATES: 2373.- Idaho, South Fork of Lake Fork Creek, McCall, Valley Co., 12.7.1962, leg. A.H. Smith 65350, TYPE (MICH).

Rhizopogon verii Pacioni

European collections. **SPAIN**: 767.- Madrid, El Escorial, carretera de Pequerinos, bosque mixto *Pinus* y *Quercus*, 17.11.1989, leg. F.D. Calonge (BCC-MPM 1702); 2488.- Teruel, Rubiales, 23.10.1990, leg. F.D. Calonge (BCC-MPM 1986). **ITALY**: 2367.- Lucca, b/*Pinus pinaster*, 14.9.1984, leg. Pacioni (AQUI); 2368.- *Idem* (AQUI); 2369.- *Idem* (AQUI).

Extralimital collections. TUNISIA: 2365.- Tabarka, b/*Pinus pinaster*, 12/14.12.1982, HOLOTYPE (AQUI); 2366.- *Idem*, ISOTYPE (AQUI).

Rhizopogon villosulus Zeller

European collections. **FRANCE**: 986.- Lantenay (Côte d'Or), sous sapins de Douglas, 10.1960, leg. M. Petitberghien (PC). **GERMANY**: 773.- Oppen, Grosse Lückner (E de Merzig, Saar), plantation de *Pseudotsuga* sur sable, UTM LV 48, 49° 2N/ 6° 4E, 4.11.1972, leg. V. Demoulin 4615, as *R. hawkeri* A.H. Smith (LG, duplex BCC-MPM 1442); 774.- *Idem*, leg. V. Demoulin 4616 (LG, slide BCC-MPM 1443); 775.- Oppen, Saar, Douglasien-Fichten, Buntsandstein, Rottiegendes, 29.8.1970, leg. G. Gross 389 (LG, slide BCC-MPM 1457); 776.-

Menningen, Saar, Douglasien-Fichten, Muschelkalk, 20.8.1970, leg. G. Gross, as *R. hawkerae* A.H. Smith (Gross 383); 955.- *Ibidem*, 21.10.1967, leg. G. Gross (Gross 102); 777.- Merzig, Saar, Douglasien, Muschelkalk, 22.10.1968, leg. G. Gross, as *R. parksii* A.H. Smith (Gross 240); 956.- Oppen, Saar, Douglasien-Fichten, Buntsandstein, 9.11.1968, leg. G. Gross, as *R. parksii* A.H. Smith (Gross 254); 982.- *Idem*, 12.8.1968, leg. G. Gross (Gross 182); 983.- *Idem* (anderer Standtort als 182), 12.8.1968, leg. G. Gross (Gross 183); 984.- *Idem*, 2.7.1968, leg. G. Gross (Gross 153); 985.- Honzrath, Saar, Douglasien, Muschelkalk, 22.8.1968, leg.Gross (Gross 193); 988.- Fremersdorf, Saar, in 15 years old *Pseudotsuga menziesii* plantation just under moss and needle layer on calcareous soil (Muschelkalk), 3.10.1971, leg. G. Gross & G.A. de Vries (Vries 531). **ITALY**: 989.- Civago, Reggio E., Douglasia, 800 m, 3.8.1986, leg. A. Montecchi 1001 (duplex BCC-MPM 1525). **NETHERLAND**: 780.- Roadside Baarn to Bilthoven km blok 32-22-42, in dil. sand near *Pseudotsuga menziesii* under *Quercus robur*, 19.8.1960, leg. G.A. de Vries, as *R. hawkerae* A.H. Smith (Vries 846); 958.- Nunspeet, Ronde Huis, on the side of a bitumenized road through the wood, under *Pseudotsuga menziesii* and *Larix*, 8.11.1989, leg. L. Bonhof, as *R. hawkerae* A.H. Smith (Vries 1260). **PORTUGAL**: 781.- Madeira, toward Poiso, grove of *Pseudotsuga* 2.5 km, 13.1.1977, leg. R.P. Korf et al., as *R. subareolatus* A.H. Smith (CUP 1508); 782.- Madeira, mixed forest at Ribeiro Frio, hypogeous under *Pseudotsuga menziesii*, 13.1.1977, leg. R.P. Korf et al., as *R. subareolatus* A.H. Smith (CUP 1501); 783.- *Idem* (CUP 1502); 784.- Madeira, Queimadas, hypogeous under *Pseudotsuga menziesii*, 880 m., 18.1.1977, leg. R.P. Korf et al., as *R. subareolatus* A.H. Smith (CUP 1611). **SPAIN**: 752.- Girona: Costa del Montseny, bajo *Pseudotsuga menziesii*, 20.11.1992, leg. M. Tabarés, R. Rocabruna & J. Vila (BCC-MPM 1609); 753.- *Ibidem*, 4.1993, leg. A. Rocabruna (BCC-MPM 1628); 990.- Girona: Montseny, *Pseudotsuga menziesii*, plantación 40-50 años, pH suelo 5.5, 2.12.1987, leg. X. Parladé, as *R. subareolatus* A.H. Smith (MA-Funig 28344); 991.- *Idem* (MA-Fungi 28346); 992.- *Ibidem*, 29.11.1987, leg. X. Parladé, as *R. subareolatus* A.H. Smith (MA-Fungi 28345); 993.- *Idem* (MA-Fungi 28348); 994.- *Idem* (MA-Fungi 28349); 995.- *Ibidem*, 2.11.1987, leg. X. Parladé (MA-Fungi 28347); 996.- *Ibidem*, 9.11.1988, leg. X. Parladé (MA-Fungi 28350); 997.- *Ibidem*, 23.11.1988, leg. X. Parladé (MA-Fungi 28351); 2327.- Girona: Montseny, "El Vilar", sixty fruitbodies under *Pseudotsuga menziesii*, 13.5.1993, leg. A. Sánchez & M.P.M. (BCC-MPM 1639); 2328.- *Idem*, two fruitbodies (BCC-MPM 1640); 2329.- *Idem* (BCC-MPM 1641); 2330.- *Idem*, two fruitbodies (BCC-MPM 1642); 2331.- *Idem*, five fruitbodies (BCC-MPM 1643); 2332.- *Idem*, five fruitbodies (BCC-MPM 1644); 2334.- *Idem*, four fruitbodies (BCC-MPM 1645); 2335.- *Idem*, eigth fruitbodies (BCC-MPM 1646); 2336.- *Idem*, fourteen fruitbodies (BCC-MPM 1647); 2337.- *Idem*, thirty six fruitbodies (BCC-MPM 1648); 2338.- *Ibidem*, 23.12.1993, leg. A. Sanchez & M.P.M. (BCC-MPM 1794); 2339.- *Idem* (BCC-MPM 1795); 2340.- *Ibidem*, 17.3.1994, leg. A. Sánchez (BCC-MPM 1800); 2341.- *Ibidem*, seven fruitbodies, 19.5.1994, leg. A. Sánchez & M.P.M (BCC-MPM 1855); 2342.- *Idem*, two fruitbodies, 19.5.1994, leg. A. Sánchez & M.P.M. (BCC-MPM 1856); 2343.- *Idem*, eleven fruitbodies (BCC-MPM 1857); 2344.- *Idem*, five fruitbodies (BCC-MPM 1858); 2345.- *Idem* (BCC-MPM 1864); 2451.- *Ibidem*, 16.10.1994, leg. J. Llistosella (BCC-MPM 1891). **UNITED KINGDOM**: 756.- England, Wykehorn (Flora of Yorksire), near surface, two years old Douglas fir, 6.11.1990, leg. L. Walker, ex Herb. Watling 22553, as *R. colosus* A.H. Smith (E); 966.- England,Whitedown plantation, West Dean Woods, South Downs (Flora of West Sussex), Grid Ref: SU 81 851 133, 24.5.1977, leg. E. Davison 27.1, as *R. roseolus* (E); 967.- *Idem*, leg. E. Davison 27.2 (E); 968.- *Idem*, leg. E. Davison 27.3 (E); 969.- *Idem*, leg. E. Davison 27.4 (E); 970.- *Idem*, leg. E. Davison 27 (E); 971.- England, Somerset, Mendip Lodge Wood, 28.9.1953, leg. L.E. Hawker 847, TYPE of *R. reticulatus* L. Hawker (K); 972.- *Ibidem*, 28.9.1954, leg. L. Hawker 1086 (K); 973.- *Idem*, 28.9.1954, leg. L. Hawker 1087 (K); 974.- *Ibidem*, Leg. L. Hawker 994, PARATYPE of *R. reticulatus* L. Hawker (K); 976.- *Ibidem*, leg. L. Hawker 993, PARATYPE of *R. reticulatus* L. Hawker (K); 987.- Scotland, Perthshire, Dunkeld, The Hermitage, Inver, under *Pseudotsuga*, 26.9.1983, leg. M. Jeppson (Jeppson 1566).

Extralimital collections. UNITED STATES: 754.- Oregon, Bear Springs, Mount Hood, Clackamas Co., 24.10.1954, leg. C. Goetz, PARATYPE of *R. colossus* A.H. Smith var. *colossus* (UPS); 755.- *Ibidem*, 25.10.1964, leg. Oswalds 182, as *R. colossus* A.H. Smith var. *nigromaculatus* A.H. Smith (UPS); 771.- Oregon, Washington, Pend Oreille County, near Cusick, 15.7.1964, leg. A.H. Smith 68417, PARATYPE of *R. hawkerae* A.H. Smith (UPS, slide BCC-MPM 2001); 772.- New Mexico, Sandoval County, Jemez Mountains, 20.9.1967, leg. K. A. Harrison 7142, as R. hawkeri A.H. Smith (UPS); 785.- *Idem* (E); 778.- California, Siskiyou County, N of Hill, Fruit Growers Supply County, hypogeous under Abies magnifica and Pinus poderosa, 23.10.1977, leg. J. Trappe 5142, as *R. hawkeri* A.H. Smith (Gross 734); 779.- *Idem* (M); 954.- Oregon, Tillamook County, Van Duzer State Park, hypogeous under Douglas fir, 8.10.1970, leg. J. Trappe, as *R. parksii* A.H. Smith (Cryp. Collec. Oregon State Univ. 2283) (LG, slide BCC-MPM 1450); 959.- *Idem* (E); 960.- *Idem* (M); 957.- Oregon, Washington, Skamania County, Wind River Forest Nursery, hypogeous under Douglas-fir trees at edge of nursery, 13.10.1977, leg. J. Trappe, as *R. parksii* A.H. Smith (Crypt. Collec. Oregon State 5127) (Gross 739); 961.- Oregon, Marion County, Silver Falls State Park, 10.10.1977, leg. Randy Molina, ex Herb. Trappe 5115, as *R. parksii* A.H. Smith (M); 1218.- Oregon, Portland, Mountain Hood, nat. forest, 8.10.1966, leg. Portland Mycol. Club, ex Herb. Watling 3868 (E); 2277.- California: Darlingtonia, Smith River, Del Norte County, on soil under *Libocedrus* and *Pseudotsuga*, over 400 in one small area, November 1939, Leg. H.E. & S.T. Parks 6363 as *R. maculatus* Z. & D. (California Fungi 713) (UPS, slide BCC-MPM 2013); 2278.- *Idem* (PAV); 2279.- *Idem* (LUND); 2280.- *Idem* (G); 2281.- *Idem* (PRM 560912); 2282.- *Idem* (W 2276); 2283.- *Idem* (H); 2320.- *Idaho*: Payette Lakes, Valley Co., in soil under a lumber pile, 26.8.1954, leg. A.H. Smith 46703, PARATYPE of *R. colossus* A.H. Smith var. *colossus* (E); 2321.- Oregon, Portland, Multnomah Co., under Douglas fir, 10.11.1956, leg. R. Oswald, PARATYPE of *R. colossus* A.H. Smith var. *colossus* (E); 2323.- California, Trinidad, Spruce Cove, under *Picea sitchensis* Carr., eight or ten specimens on top of soil beneath the needles, leg. H.E. Parks 4626, HOLOTYPE of *R. parksii* A.H. Smith (NY); 2324.- Oregon, Wallowa county, Hat Point along Snake river Canyon, 23 miles above Imnaha, under duff of conifers, 26.7.1939, leg. H.M. Gilkey, TYPE (NY); 2325.- *Ibidem*, 26.7.1939, A.M. Rogers, PARATYPE (NY).

Rhizopogon vinicolor A.H. Smith

European collections. **FRANCE**: 999.- # Forêt des Colettes, b/ *Pseudotsuga*, 15.10.1986, leg. B. Duhen (Mornand 8607 G). **ITALY**: 1005.- Südtirol, sur le bord d'un chemin, 4.1911, ex Herb. P. Magnus (HBG). **UNITED KINGDOM**: 1000.- England, New Forest, ornamental Drive, 31.8.1978, leg. E. Davison 95, slide BCC-MPM 2086); 1001.- *Ibidem*, leg. E. Davison 93 (E, slide BCC-MPM 2085); 1002.- *Ibidem*, between trees 52 + 53, leg. E. Davison 92 (E); 1003.- *Ibidem*, leg. E. Davison 96 (E); 1004.- *Ibidem*, leg. E. Davison 99 (E).

Extralimital collections. UNITED STATES: 998.- Idaho, Graham, Boise Co., under fir and ponderosa pine, 14.7.1963, leg. E. Trueblood 2195, HOLOTYPE (MICH).

Unidentified collections

AUSTRIA: 2170.- Baumgarten Park, 7.1922, leg. Beck (PRC); 2173.- Gaming, in silvis, 9.1830, as *R.luteolus* Fr. **BELGIUM**: 2169.- Aerschot, dans la terre sablonneuse des sapinières, 11.1883, leg. E. Marchat, as *R. rubescens* Tul. (Roumeguère, Fungi Gallici exsiccati 2844) (PAV). **CZECH REPUBLIC**: 2171.- Moravia merid., Rohalec, Hodomín, ad viam in silv. frond., as *R. rubescens* (PRC); 2200.- Mnichovice, Bíla Shála, 8.1932, leg. J. Velenovský, as *R. sulphureus* Vel (PRM 154787). **DENMARK**: 2178.- Sjælland, Asserbo Plantage, 14.9.1974, as *R. luteolus* Fr. (C); 2179.- Jylland, Ho Plantage ved Varde, 18.10.1968, as *R. luteolus* Fr. (C). **FRANCE**: 2162.- Herimoncourt, coudriers, leg. L. Quélet, as *R. suavis* Quél. (UPS); 2168.- Dans les lieux sablonneux, les bois de Sapins, as *R. luteolus* Fr. (Desmazières, Pl. Crypt. France 1013) (PAV); 2174.- Environs de Troyes, 27.10.1886, leg. Briardi (PC); 2185.- Dans les bois de sapin des Flandres, as *R. luteolus* Fr. (Westendorp G.B. u. Wallays A.C.F., Herbier cryptogamique

Belge 1841-1859) (M); 2187.- Herlem, 12.12.1942, leg. Solvat, ex Herb. Soehner 1889, as *R. luteolus* (M); 2204.- Hyères, Var, 12.1847, leg. Tulasne, as *R. provincialis* (PC); 2205.- *Idem*, as *R. galloprovincialis* Tul. (PC); 2206.- Nice, 12.1888, leg. M. Barla, as *R. provincialis* Tul. (M). **GERMANY**: 2163.- Germany, as *R. angustisepta* Zeller & Dodge (BUCM); 2177.- Grünewald near Berlin, 9.1887, leg. P. Hennings, as *R. luteolus* Fr. (C); 2181.- Bei Mahlow bei Berlin, Kiefernwald in Sandboden, 31.5.1946 ex Herb. Soehner 2143, as *R. rubescens* Tul. (M); 2182.- Unterfranken, Gemünden, unterer Muschelkalk, 28.8.1982, leg. R.A. Hintz, as *R. rubescens* var. *rubescens* A.H. Smith (M); 2183.- Mahlow bei Berlin, Kiefernwald in Sandboden, 12.7.1946, ex Herb. Soehner 2143, as *R. rubescens* Tul. (M); 2186.- Zobten bei Klein-Silster-witz (Schlesien), 23.7.1915, leg. S. Oberl, ex Herb. Soehner 1177, as *R. luteolus* (M); 2198.- Namiest, 1867, leg. Niessl ex herb. Barbey-Boissier, as *R. rubescens* Tul. (GE); 2202.- Lindelbach, 24.4.1983, leg. R.A. Hintz (M); 2203.- Unterfranken, Alnus glutinosa, 15.9.1984, leg. R.A. Hintz (M). **NETHERLANDS**: 2176.- Heide, Huis, 10.1915, leg. J.A.R. von Stolk, as *R. virens* (Alb. & Schw.) Fr. (L); **ITALY**: 2201.- Trento, weitere (photo A. Bresinsky) (M); **SPAIN**: 1305.- Mallorca, sur sol dans une pinède, 18.10.1977, leg. D. Thosen 6682 (LG); 2207.- Pontevedra, Bueu, *Pinus pinaster*, 28.11.1986, leg. M. Dueñas, as *R. roseolus* (Corda) Th. Fr. (MA-Fungi 28339); 2379.- Pontevedra, Isla Cortegada, 13.11.1986, leg. M. Castro, as *R. luteolus* Fr. & Nordholm (Castro 585); 2486.- Madrid, Siete Picos, 18.9.1929, leg. B. Lazaro (MA-Fungi 2975). **UNITED KINGDOM**: 2172.- England, Cap. bon. Spei, inter acus pinorum in silva, "Rondebosch", prope Somerset-East, 5.1882, leg. P.Mac Owan, as *Melanogaster owanianus* Kalchbr. (Rabenhorst-Winter, Fungi europaei 3436) (WU); 2175.- England, Bicton Common, 9.1967, leg. L. Hawker ex Herb. Watling 5328, as *R. luteolus* (E); 2199.- England, Somerset, Cleeve Cliff, under pine, 25.9.1953, leg. J. Fraymouth 242, as *R. rubescens* (K); 2208.- England, New Forest, Knightwood, Vinney Enclosure, 3.9.1954, ex Heb. Hawker 1080, as *R. provincialis* (K). **SWEDEN**: 2209.- Södermanland, Dalaro skärgård, Närdo, as *R. luteolus* Fr. (UPS); 2193.- Illegible label, 1894, Lönnegren (not samples, watercolour), as *R. luteolus* Fr. (UPS); 2194.- Gotland, Gotska Sandön, Arnagrop, vandringsdynens läsida, 18.8.1958, leg. B. Petterson, as *R. luteolus* Fr. (UPS); 2195.- Västergötland, Lerum s.n, Timmerån, 8.1902, leg. A. Södergren, as *R. luteolus* (UPS); 2196.- Närke, Bodarne sn, Tueden, 1882, leg. P.N. Bredin, as *R. luteolus* (UPS). 2180.- Without loc., leg. M. Lange as *R. luteolus* Fr. (C); 2184.- In pinetis mox hypogaeus mox vertice emersus ab Augusto in autummum usque, as *R. luteolus* Fr. (Rabenhorst, Herb. mycologicum Ed. II, 320) (M); 2188.- *Idem* (HBG).

Extralimital species

Rhizopogon albidus A.H. Smith

Extralimital collections. UNITED STATES: 2265.- Idaho, Black Tip Ridge, McCall, Valley Co., 22.8.1964, leg. A.H. Smith 69638 (UPS, slide BCC-MPM 2001); 2266.- Idaho, Cougar Mountain, McCall, Valley Co., 22.8.1964, leg. A.H. Smith 69648, PARATYPE (OSC); 2348.- *Idem*, leg. A.H. Smith 69642, PARATYPE (E).

Rhizopogon atroviolaceus A.H. Smith

Extralimital collections. UNITED STATES: 2267.- Idaho, Heaven's Gate, Seven Devils Mount., Idaho Co., 27.8.1964, leg. A.H. Smith 69810, PARATYPE (UPS, slide BCC-MPM 2002); 2349.- *Idem*, leg. A.H. Smith 69179, PARATYPE (E, slide BCC-MPM 2207).

Rhizopogon brunneicolor A.H. Smith

Extralimital collections. UNITED STATES: 2350.- Idaho, Priest River, Bonner Co., 27.7.1964, leg. A.H. Smith 68666, PARATYPE (E, slide BCC-MPM 2208).

Rhizopogon cokeri A.H. Smith

Extralimital collections. UNITED STATES: 2268.- Nova Scotia, Coldbrook, Kings Co., under mixed pines, leg. K.J. Harrison 12101 (UPS, slide BCC-MPM 2003).

Rhizopogon couchii A.H. Smith

Extralimital collections. UNITED STATES: 2269.- N.C., Brookgreen Gardens, Charleston Co., 29.12.1966, leg. S.J. Mazzer 4721 (UPS, slide BCC-MPM 2006).

Rhizopogon diabolicus A.H. Smith

Extralimital collections. UNITED STATES: 2351.- Washington: Cusik, Pend Oreille Co., under Douglas fir, 15.7.1964, leg. A.H. Smith 68424, PARATYPE (E).

Rhizopogon idahoensis A.H. Smith

Extralimital collections. UNITED STATES: 2273.- Idaho, Warm lake, Valley Co., under pine, leg. A.H. Smith 66207, PARATYPE (UPS); 2274.- Washington, Cusick Woods, Cusick, Pend Oreille Co., 24.9.1964, leg. A.H. Smith 70715 (UPS); 2276.- *Ibidem*, under Douglas fir woods, 12.10.1966, leg. A.H. Smith 74122 (UPS); 2275.- Idaho, Priest River Experimental Forest, Priest River, Bonner Co., 11.10.1968, leg. A.H. Smith 77088 (UPS).

Rhizopogon nigrescens A. H. Smith

Extralimital collections. UNITED STATES: 2564.- North Carolina, Couch 7582, LECTOTYPE [selected by Smith & Zeller, 1966] (MICH).

Rhizopogon ochraceiosporus A.H. Smith

Extralimital collections. UNITED STATES: 2287.- Washington: Rampart Ridge Trail, Mount., Rainier National Park, Pierce Co., 26.8.1948, leg. A.H. Smith 30698 (UPS, BCC-MPM 2015).

Rhizopogon ochroleucus A. H. Smith

Extralimital collections. UNITED STATES: 2375.- Idaho, Priest Lake, Bonner Co., in the campground among cedar, birch and pine, 28.9.1956, leg. A.H. Smith 53615, HOLOTYPE (MICH).

Rhizopogon ochroleucoides A.H. Smith

Extralimital collections. UNITED STATES: 2288.- Idaho, Priest River, Bonner Co, Priest River Experimental Forest, 10.7.1964, leg. A. H. Smith 68310, PARATYPE (UPS, slide BCC-MPM 2017).

Rhizopogon olivaceofuscus A.H. Smith

Extralimital collections. UNITED STATES: 821.- Idaho, Priest River Experimental Forest, Bonner Co., 20.7.1964, leg. A.H. Smith 68544, PARATYPE of *R. olivaceofuscus* A.H. Smith (UPS, slide BCC-MPM 2018); 2353.- Idaho; Near Florence, Idaho Co., 13.8.1964, leg. A.H. Smith 69291, PARATYPE (E).

Rhizopogon oswaldii A.H. Smith

Extralimital collections. UNITED STATES: 2354.- Oregon, Mt. Wilson Rd., Bear Springs, Mt. Hood National Forest, in an old horse corral, 26.10.1946, leg. W.B. Gruber, ex Herb. Smith 25065, PARATYPE (MICH); 2563.- *Idem* (UPS, slide BCC-MPM 2019).

Rhizopogon pachydermus K.A. Harrison & A.H. Smith

Extralimital collections. UNITED STATES: 2289.- New Mexico, Hyde Park Rd., near Santa Fe, Santa Fe Co., under piñón pine, 5.10.1967, leg. K.A. Harrison 7290, PARATYPE (UPS, slide BCC-MPM 2020); 2356.- *Idem*, leg. K.A. Harrison 7391, PARATYPE (MICH).

Rhizopogon pinicola A.H. Smith

Extralimital collections. UNITED STATES: 2290.- Michigan, Culhane lake, luce Co., 7.8.1975, leg. A. H. Smith 72027 (UPS); 2291.- *Ibidem*, leg. A. H. Smith 71999 (UPS, slide 2022).

Rhizopogon quercicola A.H. Smith

Extralimital collections. UNITED STATES: 965.- Oregon, Bear Springs, Wasco Co., beneath golden chinquapin oak trees, 10.1964, leg. W. Harding, HOLOTYPE (MICH).

Rhizopogon reaii A.H. Smith

Extralimital collections. UNITED STATES: 2294.- California, Santa Barbara Co., superficial, on the ground under oak, cespitose, 19.3.1945, leg. P. & M. Rea 1434, HOLOTYPE (MICH).

Rhizopogon semireticulatus A.H. Smith

Extralimital collections. UNITED STATES: 2295.- Washington, Klickitat Co., Brook Memorial State Park, 12.10.1975, under *Pinus ponderosa* (LG, duplex BCC-MPM 1452).

Rhizopogon separabilis Zeller

Extralimital collections. UNITED STATES: 2314.- Oregon, Lane County, North of Florence, in sand under *Pinus contorta*, 22.11.1935, leg. A.H. Smith, A.B. Hatch & S.M. Zeller, ex Herb. Zeller 8236, ISOTYPE (NY); 2362.- *Idem*, ISOTYPE (MICH).

Rhizopogon subcaerulescens A.H. Smith

Extralimital collections. UNITED STATES: 2296.- Washington, Skamia Co., Wind River Paradine Creek Forest Camp, hypogeous in *Tsuga-Pseudotsuga* stand, 1500 fto., 17.7.1977, as *R. subcaerulescens* A.H. Smith var. *subcaerulescens* (LG, slide BCC-MPM 1454 A and 1454 B). 2297.- Colorado, 1/4 mile of Florissant, 8.8.1973, ex Herb. Demoulin 4624 (LG).

Rhizopogon truncatus Linder

Extralimital collections. UNITED STATES: 2301.- New Hampshire, Holderness, 7.1922, leg. D.H. Linder, TYPE (FH).

Acknowlegments

Thanks to Dr. Marian Gienn (Seton Hall Univ., New Jersey, USA) for her kind English revision and to all those who sent us material as a gift or loan.

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MYCOTAXON

Volume LXXVIII, pp. 245-256 April-June 2001

STUDIES IN NEOTROPICAL POLYPORES 12 NEW AND NOTEWORTHY POLYPORES FROM MEXICO

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Abstract

Fifteen species of Polyporaceae from Mexico are discussed: three new species: *Antrodiella tuberculata*, *Tyromyces mexicanus* and *T. subviride*; eight new records for the Mexican mycobiota: *Antrodiella semisupina*, *Fomitopsis nivosa*, *Junghuhnia subundata*, *Oligoporus leucomallellus*, *Polyporus udus*, *Protomerulius substuppeus*, *Tyromyces pseudolacteus* and *Wrightoporia tropicalis*; and five known species from new localities within the country. Keys to the known neotropical species of *Antrodiella* and *Tyromyces* are also presented.

Key words: Polyporaceae, Central America.

Introduction

The previous report on Mexican polypores (Ryvarden and Guzmán, 1993) is amplied with observations on 15 species. Of these, three are new species, eight are new Mexican records while five are for known species from new localities. All records were from tropical or subtropical regions, except a few cases that will be discussed. The collections are deposited in XAL, with duplicates in O, if no other herbarium is mentioned. Those new to Mexico are indicated with *.

The knowledge of the Polyporaceae of Mexico remains poor. Bandala *et al.* (1993) recorded 573 species of polypores from Mexico, out of which Guzmán *et al.* (1997) commented upon around 100 species. Ryvarden and Guzmán (1993) reported 43 species of polypores out of which 19 were new for the country.

Taxonomy

**Antrodiella semisupina* (Berk. & M.A. Curtis) Ryvarden Fig. 1
A widespread and cosmopolitan species (Gilbertson and Ryvarden, 1986; Ryvarden and Gilbertson, 1993), common in hardwood forests. The Mexican specimens were gathered in subtropical humid forests.
Studied material. VERACRUZ, Road Xalapa to Naolinco, S of Santa Rita, 13 July 1972, *López 80* (XAL, O). Road Xalapa to Perote, near Rafael Lucio, 4 Oct. 1986, *Montoya 845* (XAL, O).

Antrodiella tuberculata Ryvarden & Guzmán nova sp. Figs. 2-3
Fructificatio sessilis, pileus ochraceus, tuberculatus, pori rotundis vel angulatis, 6-8 per mm, ochraceus, systema hyphale dimiticum, hyphae generatoriae fibulatae, basidiosporae 3-3.5 x 2-2.5 µm, subglobosae. Mexico, Veracruz, Totutla-Xalapa, Axocoapan, 29 June 1984, 1350 m altitudo, Leg. Chacon 2262 (holotypus XAL, isotypus O).
Basidioma pileate, annual, sessile to dimidiate, imbricate, tough when fresh, curled, hard and rigid when dry, up to 4 cm wide by 10 cm long and 8 mm thick at base, upper surface tuberculate and wrinkled with tuft of agglutinated hairs from the base, becoming glabrous towards the margin, concentrically zonate, ochraceous to pale straw-colored, a few narrow zones pale brown, margin sharp, pore surface ochraceous, pores tiny and invisible to the naked eye, 6-8 per mm, tubes up to 4 mm deep, isabelline and distinctly darker than the context, the latter cream, dense 2-4 mm thick. Strong smell of cinnamon when fresh.
Hyphal system dimitic; generative hyphae with clamp connections, dominating in the context, hyaline, thin- to thick-walled, 2-8 µm wide, those of the context with often thick walls and large conspicuous clamp connections, skeletal hyphae rare, thick-walled to solid, hyaline, 4-8 µm wide. *Cystidia* absent, but numerous smooth cystidiols present in the hymenium, probably representing aborted basidia, 12-15 µm long. *Basidia* 12-15 x 3-4 µm, 4-sterigmate, clavate, with a basal clamp connection. *Basidiospores* 3-3.5 x 2-2.5 µm, subglobose, hyaline, smooth, negative in Melzer's reagent.
Habitat and distribution. On an unknown dead deciduous trunk. Known only from the type locality.
Remarks. This species is characteristic by its densely tuberculate pileus and the small subglobose basidiospores. The hyphal system is somewhat deviating as generative hyphae dominate in the context. There are long segments of these hyphae without clamps and isolated and they may easily be taken for skeletal hyphae. *Antrodiella semisupina* is macroscopically similar, but has distinctly ellipsoid

basidiospores and the context is dominated by skeletal hyphae.

Antrodiella versicutis (Berk. & M.A. Curtis) Gilbn. & Ryvarden
This species is known from Southeastern U.S.A. to Brazil (Gilbertson and Ryvarden, 1986). It was first recorded in Mexico by Ryvarden and Guzmán (1993) from four tropical forests localities in Quintana Roo. It is now reported from a new tropical forest in Chiapas.
Studied material. Chiapas, Ocosingo, 2 km W of Plan de Ayutla, 22 January 1984, *Sampieri 770* (XAL, O).

Key to the known neotropical species of *Antrodiella*
1. Basidiocarp resupinate .... **A. incrustans**
1. Basidiocarp pileate 2

2. Pores 1-3 mm wide.. **A. angulatoporia**
2. Pores 4-8 per mm 3

3. Basidiospores allantoid or oblong ellipsoid, up to 2 µm wide 4
3. Basidiospores broadly ellipsoid to subglobose, wider than 2 µm....... 6

4. Basidiospores oblong ellipsoid, 3-4 x 1.0-2 µm .... **A. murrillii**
4. Basidiospores allantoid to cylindrical 4-4.5 x 1-1.5 µm 5

5. Pileus brown to pale chestnut, pores 10-12 per mm, context dominated by almost solid skeletal hyphae .... **A. versicutis**
5. Pileus ochraceous to pale brown, pores 6-7 per mm, context dominated by wide generative hyphae, only few skeletal hyphae present **A. duracina**

6. Basidiospores 4-5 x 3 µm .... **A. reflexa**
6. Basidiospores shorter than 4 µm 7

7. Pileus cream to straw-coloured or pale brown, context more or less as the tubes or paler, basidiomata often effused reflexed 8
7. Pileus brown to purplish black or chestnut, context brown and darker than the tubes, basidiomata mostly fanshaped with tapering base 9
8. Upper surface tuberculate and tufted, basidiospores subglobose, context dominated by wide generative hyphae .... **A. tuberculata**
8. Upper surface more or less smooth, basidiospores ellipsoid, context dominated by skeletal hyphae, generative hyphae narrow and inconspicuous.. **A. semisupina**

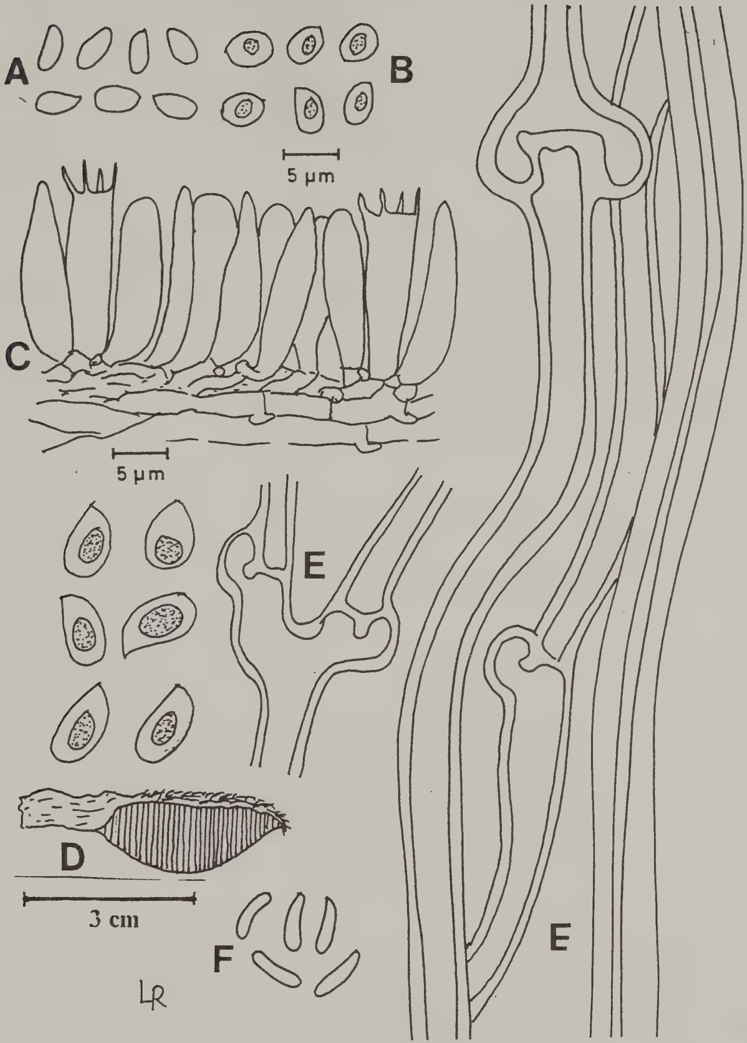
9. Pileus finely tomentose, slowly becoming glabrous, no hymenial cystidia present, context with dark horizontal lines, with age dense and resinous .... **A. hydrophila**
9. Pileus glabrous, small smooth cystidia arising from bent skeletal hyphae in the hymenium, no narrow resinous band in context.. **A. liebmannii**

Bondarzewia berkeleyi (Fr.) Bondartsev & Singer
This is a rare species sometimes foound with giant basidioma, up to 100 cm wide and up to 30 kg in weight (Guzmán-Dávalos and Trujillo, 1984). It was reported by Guzmán and Varela (1979) for the States of Guerrero, Hidalgo and Michoacan and by Guzmán-Dávalos and Trujillo (1984) for Jalisco. It is now reported for the first time for the State of Puebla. *Bondarzewia montana* (Quél.) Singer is related and usually separated only by its habitat, in conifers forests vs. deciduous forests for *B. berkeleyi*. However, as discussed Guzmán and Varela (1979), this is a dubious character since in Mexico it occurs from the humid subtropical (mesophilic) forests to the conifers forests. The shape and colour of the basidioma are identical in both type of forests and DNA sequencing is desirable to settle the status of these two species.

The basidiomata may easily be mistaken for an *Albatrellus* species in the field. However, microscopically, the globose and strongly amyloid basidiospores will immediately exclude this genus where all species are known to have smooth basidiospores.

DNA investigations (Hibbit et al. 1997) has shown that . *Bondarzewia* belongs in the socalled *Hericium* clade where all genera except *Peniophora* are characterized by amyloid basidiospores and a variable occurrence of gloeocystidia. All types of different hymenophores are present in this clade and typical genera are *Russula, Stereum, Clavicorona, Lentinellus, Auriscalpium* and *Heterobasidion* to mention a few.
Studied material. PUEBLA, Eastern Iztaccihuatl, San Juan Tetla, 15 Aug. 1965, *May-Nah* (ENCB, O, XAL).

**Fomitopsis nivosa* (Berk.) Gilbn. & Ryvarden
A widespread pantropical species, in America known from the Gulf Coast Region (Gilbertson and Ryvarden, 1986) to Southern Brazil.
Studied material. VERA CRUZ, Estacion biologica ?El Moro de la Mancha, reserve ecologic INIREB, Mpio. De Actopan, 6 m, August 25, 1983, Sampieri 124 (O).



Figs. 1-9.- 1: *Antrodiella semisupina*, basidiospores. 2-3: *A. tuberculata*, 2, basidiospores, 3, hymenium. 4-6: *Tyromyces mexicanus*, 4, section through the basidioma, 5, hyphae from the context, 6, basidiospores. 7: *Tyromyces subviridis*, basidiospores. 8-9: *Polyporus udus*, 8: spores, 9: hyphae from the context (1-7 from the holotypes; 8-9 from Guzmán 30414).

**Junghuhnia subundata* (Murrill) Ryvarden
This is rather widespread in the Caribbean region (Ryvarden 2000a & b). The cystidia may be difficult to observe. The Mexican specimen was collected in a humid subtropical (mesophilic) forests, at 1300 m.
Studied material. VERACRUZ, Xalapa region, old road to Coatepec, Botanic Garden Francisco J. Clavijero, 7 May 1986, *Anell 299* (XAL, O).

**Oligoporus leucomallellus* (Murrill) Gilbn. & Ryvarden
A widespread species, originally described from Florida (U.S.A.) but circumpolar in the conifer region (Gilbertson and Ryvarden, 1987; Ryvarden and Gilbertson, 1994). .
Studied material. VERACRUZ, Eastern region of Cofre de Perote, S of Tembladeras, El Revolcadero, on *Pinus patula* Schl. & Cham., at 2850 m, 16 Oct. 1984, *Villarreal 1645* (XAL, O).

Phellinus roseocinereus (Murrill) D. A. Reid
A rare neotropical fungus known from Costa Rica and Cuba (Murrill, 1908). It is closely related to *Ph. callimorphus* (Lév.) Ryvarden from Africa (Ryvarden and Johansen, 1980), but is separated by wider setae. It was reported from Mexico by Welden *et al*. (1979) from Oaxaca and by Guzmán (1983) from Quintana Roo. This is the first record for Veracruz.
Studied material. VERACRUZ, Xalapa region, old road to Coatepec, Botanic Garden Francisco J. Clavijero, 13 March, 1990, *Ochoa 2* (ENCB, XAL, O). Near Huatusco, road to Fortin, July 20, 1983, *Chacón 1190* (XAL, O). (Vera Cruz, Cerca de Fortin, Carretera a Huatusco, 1100 m, G. Guzman 7. Aug. 1976 (O).

Polyporoletus sublividus Snell
This rare species has a robust and stipitate basidioma, up to 12 cm diam. and large pores, up to 1 mm wide. It grows on soil under hardwood or conifer trees (Gilbertson and Ryvarden, 1987; Nava and Valenzuela, 1993) and may be suspected to be ectomycorrhizal. Its double-walled basidiospores are unique in the fungal kingdom and only sequence data will give us a key to its origin. It was reported from Mexico by Nava and Valenzuela (1993) from the States of Mexico, Michoacan and Morelos. It is here reported for the second time from Michoacan and for the first time from Durango.
Studied material. DURANGO, Reserva de la Biósfera La Michilia, Estación Biológica, 21 Aug. 1982, *Fanti 243* (ENCB, XAL, O).

MICHOACAN, road Morelia to Ciudad Hidalgo, Puerto Garnica, Sept. 6, 1981, *Dávalos 263* (ENCB, O, XAL).

Polyporus grammocephalus Berk.
A pantropical species (Ryvarden and Johansen (1980), reported by Pérez-Silva (1971) from Chiapas and by Guzmán (1983) from Quintana Roo. This is the first record for Veracruz.
Studied material. VERACRUZ, near Cordoba, road to Huatusco, 8 July 1983, *Guzmán 23322* (XAL, O).

**Polyporus udus* Jungh. Figs. 8-9
A pantropical species belongs to *P. squamosus* Huds.: Fr. group, with variable pileus surface in colour and presence of small squamules. The neotropical collections are often darker on the pileus than African and Asiatic specimens. Further studies may show that there are several species involved. The basidioma developes first with a monomitic hyphal system and takes a long time to reach the dimitic system.All Mexican specimens are monomitic. It is known from only one locality where it has recurred yearly for almost ten years, growing solitary on rotten logs of *Inga jinicuil* Schl. in a disturbed humid subtropical (mesophytic) forest.
Studied material. VERACRUZ, S of Xalapa, old road Xalapa to Coatepec, S of La Pitaya, Region of Zoncuantla, 1 Nov. 1992, *Guzmán 30414*; 10 Nov. 1992, *Guzmán 30606*; 2 July 1993, *Guzmán 30691*; 4 April 1995, *Guzmán 31111*; 27 Sept. 1995, *Guzmán 31296*; 10 March 1996, *Guzmán 31371*; 1 May 1996, *Guzmán 31376*; 1 June 1996, *Guzmán 31406b* (all in XAL, but 31296, 31371 and 31376 also in O).

**Protomerulius substuppeus* (Berk. & M.A. Curtis) Ryvarden
The species is widespread in Central and South America and described several times both by Rick and Lloyd as new species.(Setliff & Ryvarden 1982). It belongs in Tremellales because its cruciate basidia. In the field it is easily mistaken for a *Tyromyces* species because of its white and sappy basidioma.
Studied material. VERACRUZ, Region of La Mancha, Reserva Ecológica del Instituto de Ecología, 13 Aug.1984, *Chacón 2465* (O, XAL).

Tyromyces mexicanus Ryvarden & Guzmán nova sp. Fig. 4-6
Fructificatio pileata, pileus brunneus, striatum radiatim, pori albis, angulatis 2-3 per mm, contextibus cinereis, systema hyphale

monomiticum, hyphae generatoriae hyalinae, fibulatae, basidiosporae 6-7 (-8) x 3.5-4 µm, ellipsoideae. Mexico, Veracruz, Prope Cofre de Perote, Los Gallos, septentrionalis Ingenio El Rosario, 29 August 1990, Leg. Murrieta 223 (holotypus XAL; isotypus O).

Basidioma annual, pileate, dimidiate with distinctly tapering base, outer part, about 4.5 cm in diameter, up to 15 mm thick, soft when fresh, hard and fragile when dry, upper surface dark greyish brown, strongly radially fimbriate to striate, in parts with small erect tufts of agglutinated hairs, slightly concentrically zonate, margin as pileus, but extended beyond the pileus proper as a veil, 1-3 mm wide, in dry condition bent down covering the marginal pores, pore surface white, pores angular and slightly dentate, 2-3 per mm, tubes white, up 12 mm deep, context homogenous, whitish, becoming greyish towards the upper surface, 1-2 mm thick.

Hyphal system monomitic; generative hyphae with clamp connections, thin- to slightly thick-walled, 3-7 µm wide, with large conspicuous clamps. *Cystidia* absent. *Basidia* 20-28 x 5-6 µm, with 4 sterigmata, clavate, with a basal clamp. *Basidiospores* 6-7(-8) x 3.5-4 µm , ellipsoid, hyaline, with a large oil drop.

Habitat and distribution. On a dead coniferous log in a *Pinus* and *Abies* forest. Known only from the type locality.

Remarks. This is a remarkable species with its dark striate pileus, white pore surface and a thin white to grey context. It is close to *T. pelliculosus* (Berk.) G. Cunn., but that species has a hirsute to strigose pileus and smaller basidiospores (4.5-6 x 3-4 µm), and it is only known from Australia and Africa (Ryvarden & Johansen 1980).

**Tyromyces pseudolacteus* Murrill

This a rare neotropical species, originally described from Florida (U.S.A), and it is also know from Venezuela (Ryvarden & Iturriaga 2000).

Studied material. VERACRUZ, Xalapa, old road to Coatepec, Botanic Garden Francisco J. Clavijero, 30 Sept. 1982, *Brown 727* (O, XAL).

Tyromyces subviride Ryvarden & Guzmán nova sp. Fig 7

Fructificatio pileata, pori subviridis, angulatis 5-6 per mm, tubi subviridis, contextibus albidis, systema hyphale monomiticum, hyphae generatoriae hyalinae, fibulatae, basidiosporae 3.5-4 x 1-1.5-2 µm, allantoideae. Mexico, VERACRUZ, Prope Cofre de Perote, Los Gallos, septentrionalis Ingenio el Rosario, 8 January, 1991. Leg. Tapia 468 (holotypus XAL; isotypus O).

Basidioma annual, pileate, broadly attached and elongated along the substrate, up to 5 cm long, 1 cm wide and 5 mm thick at the base, upper surface glabrous, ochraceous, smooth when fresh, slightly radially wrinkled when dry, azonate, margin sharp and thin, deflexed in dry condition, covering with marginal pores, pore surface greyish green, pores sinuous to angular, with dentate and lacerate mouths, 5-6 per mm, in part larger due to shrinking under drying, 1-2 per mm, tubes greenish to pale grey, up to 4 mm deep, resinous fragile, context white and dense, 1-2 mm thick.

Hyphal system monomitic; generative hyphae with large conspicuous clamp connections, thin to thick-walled, 3-8 µm wide. *Cystidia* absent. *Basidia* 10-14 x 4-5 µm with 4 sterigmata, clavate. *Basidiospores* 3.5-4 x 1-1.5 µm, allantoid, hyaline, thin-walled.

Habitat and distribution. On a log of an uindentified tree. Known only from the type locality.

Remarks. The species is recognized by narrow glabrous pileus, the distinct grey to pale green pores surface with dentate pore mouths and the tubes that distinctly contrast to the much paler context. For the colour of the pore surface the species is like to *T. fumidiceps* G.F. Atk., but this species has a hispid to tomentose upper surface and small ellipsoid basidiospores.

Key to neotropical species of *Tyromyces*

1. Basidioma stipitate to semistipitate 2
1. Basidioma sessile-dimidiate 4

2. Basidiospores 4-4.5 µm long, pileus warm chocolate brown ....**T. polyporoides**
2. Basidiospores longer than 6 µm, pileus differently colored 3

3. Basidioma reddish, basidiospores 6-8 µm long .... **T. singeri**
3. Basidioma beige to wood-coloured, basidiospores 8-10 µm long .... **T. aquosus**

4. Spores allantoid to cylindric 5
4. Spores ovoid-ellipsoid 11

5. Gloeocystidia present .... **T. hypocitrinus**
5. Gloeocystidia absent 6

6. Basidiospores 5-6 µm long, pores 3-4 per mm, bulbous cystidia present in the dissepiments .... **T. nodulosus**
6. Basidiospores shorter than 5 µm, pores 4-9 per mm, cystidia absent in the dissepiments 7

7. Pore surface and tubes greyish green, pores angular and dentate, 5-6 per mm, on drying becoming irregular in parts .... **T. subviride**
7. Pore surface and tubes whitish to ochraceous, pores round to slightly angular, more or less unchanged by drying 8

8. Upper surface pale reddish to dark brown, pores 4-7 per mm 9
8. Upper surface whitish to pale yellow, pores 7-9 per mm 10

9.Upper surface strigose by bundles of stiff dark brown hairs.. **T. neostrigosus**
9. Upper surface adpressed velutinate to glabrous .... **T. preguttulatus**

10. Upper surface pale yellow, glabrous, basidioma rarely more than 3 mm thick .... **T. caesioflavus**
10. Upper surface white to cream, velvety to tomentose, basidioma 1-2 cm thick .... **T. leucomallus**

11. Basidioma contracting strongly and become dense and resinous with drying, sessile to dimidiate, up to 12 cm wide............**T. subgiganteus**
11.Basidioma not contracting and becoming dense by drying 12

12. Context duplex with a dark resinous zone separating upper and lower part, generative hyphae up to 10 µm wide in the context .... **T. limitatus**
12. Context more or less homogenous and without a dense dark line, generative hyphae rarely above 5 µm wide 13

13 Upper surface dark brown, radially striate and strigose, basidiospores 6-7 (8) x 3.5-4 µm .... **T. mexicanus**
13. Upper surface whitish or cream to grey, velutinate to glabrous, basidiospores shorter than 6 µm 14

14. Upper surface white to grey becoming beige to pale reddish brown, soon glabrous, and becomes brown when bruised in fresh condition with strong odor of anise when fresh....................................... **T. atroalbus**
14. Upper surface white to cream or ochraceous, and more or less unchanged when bruised in fresh condition, no distinct smell of anise

when fresh 15

15. Upper surface white and silky velvety, pores angular 3-5 per mm, basidiospores 3.5-4.5 x 2.5-3.5 µm .... **T. xuchilensis**
15. Upper surface white to cream, tomentose to scrupose, becoming glabrous in parts, pores round to angular, 4-6 per mm, basidiospores 4-5 x 2.5-3.5 µm .... **T. pseudolacteus**

Wrightoporia tropicalis (Cooke) Ryvarden
This is a neotropical and perennial species, so far the only one in the genus. It is widespread in the neotropics and known north to Puerto Rico (David & Rajchenberg 1986, Ryvarden 2000a).
Studied material. VERACRUZ, Road Catemaco to Montepio, Estación Biológica Los Tuxtlas, UNAM, 26 July 1981, *Guzmán 19669-b* (O, XAL).

Acknowledgements

The authors want to thank Florencia Ramírez-Guillén and Fidel Tapia, both assistants of Guzmán, for their valuable work in the herbarium and for collecting some specimens. Ramírez-Guillén also did microscopical work on *P. udus*. Kurt Hjortstam has acted as presubmission reviewer and his help is acknowledged.

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MYCOTAXON

Volume LXXVIII, pp. 257-263 April-June 2001

MOLECULAR DATA CONFIRM SETCHELLIOGASTER TENUIPES AND S. RHEOPHYLLUS AS CORTINARIALES

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Abstract: The analysis of ITS regions, including 5.8S rDNA, confirms that *Setchelliogaster rheophyllus* and *Setchelliogaster tenuipes* belong to the order Cortinariales. The data support that *S. rheophyllus* and *S. tenuipes* are two morphotypes of a single species. A new combination, S. tenuipes var. rheophyllus is proposed.

Key words: Basidiomycota, systematic, ITS rDNA, sequencing.

INTRODUCTION

Recently it was established that *Setchelliogaster rheophyllus* (Bertault & Malençon) Moreno & Kreisel (=*Naucoria rheophylla*) and *Setchelliogaster tenuipes* (Setchell) Pouzar (=*Secotium tenuipes* Setchell) are closely related, based on morphological and molecular data (MARTÍN & ROCABRUNA, 1999). A question that remained unresolved was the taxonomic position of these taxa at a higher level.

Many authors have included the genus *Setchelliogaster* Pouzar (1958) in the family Cortinariaceae (JÜLICH, 1981; BEATON, PEGLER & YOUNG, 1985; HAWKSWORTH & al., 1995). However, it has also been classified as belonging to other families: Cribbiaceae (SMITH in AINSWORTH, SPARROW & SUSSMAN, 1973), Crepidotaceae (SINGER, 1975, 1986), Secotiaceae (MONTECCHI & LAZZARI, 1993) and Bolbitiaceae (ARORA, 1986; MORENO & al., 1997). The presence of tibiiform cheilocystidia and hymeniderm pileipellis were the morphological features that suggested to MORENO & al. (1997) a phylogenetic relationship between the genera *Setchelliogaster* and *Conocybe*, and thus to include *Setchelliogaster* in the family Bolbitiaceae.

As a consequence of our research within the project of "Flora Micológica Ibérica", new information has been obtained from the pair of taxa mentioned above clarifying their taxonomic position.

MATERIAL AND METHODS

Material examined.- *Alnicola melinoides* (Bull.: Fr.) Kühn: SPAIN, Huelva, Aracena, Ribera de Cortelazor, 13-XI-1998 (AH 19566, MA-Fungi 41424). *Cortinarius caerulescens* (Schaeff.) Fr.: SPAIN, Gerona, La Garrotxa, 13-X-1998 (AH 19427, MA-Fungi 41427); *Cortinarius trivialis* Lange: SPAIN, Guadalajara, Codes, 18-X-1990 (AH 15917, MA-Fungi 41428); *Descomyces albus* (J.F. Klotzsch) N.L. Bougher & M.A. Castellano: PORTUGAL, Algarve, 25-III-1998 (MA-Fungi 40133); *Setchelliogaster rheophyllus* (Bertaul & Maleçon) Moreno & Kreisel: SPAIN, Huelva, Aracena, 11-I-1998 (AH-19719); and collections mentioned in MARTÍN & ROCABRUNA (1999).

Morphological characters.- Specimens were examined to define the macroscopic and microscopic characters that differentiate the two taxa. Transverse sections of the pileipellis and SEM of spore ornamentation were prepared (MORENO & al. 1997).

Molecular analysis.-Total DNA was isolated with EZNA Fungi miniprep kit (Omega Biotek) according to MARTÍN & GARCÍA-FIGUERES (1999). Primer pairs ITS1F/ITS4 (WHITE *et al.*, 1990; GARDES & BRUNS, 1993) were used to obtain amplifications of both ITS regions, including the 5.8S of the ribosomal RNA gene cluster. Amplifications were conducted using PCR Beads from Pharmacia-Biotech (WINKA *et al.* 1998). Results of amplifications were assayed from 5µl aliquots by gel electrophoresis of 1% ME-Agarose (Seakem, FMC Bioproducts). Amplification products were cleaned using EZNA (Omega Biotech) and both strands were sequenced separately using the primers mentioned above.

Sequence Navigator™ Sequence Comparison software (Perkin Elmer) was used to identify the consensus sequences from the two strands. The new sequences have been logged in the EMBL database with the Accesion Numbers AJ296301 (*Alnicola melinoides* MA-Fungi 41424), AJ296295 (*Cortinarius caerulescens* MA-Fungi 41427), AJ29296230 *Cortinarius trivialis* MA-Fungi 41428), AJ296296 (*Descomyces albus,* MA-Fungi 40133) and AJ296298 (*Setchelliogaster rheophyllus* AH-19719). Sequences obtained in this study were compared with homologous sequences in the

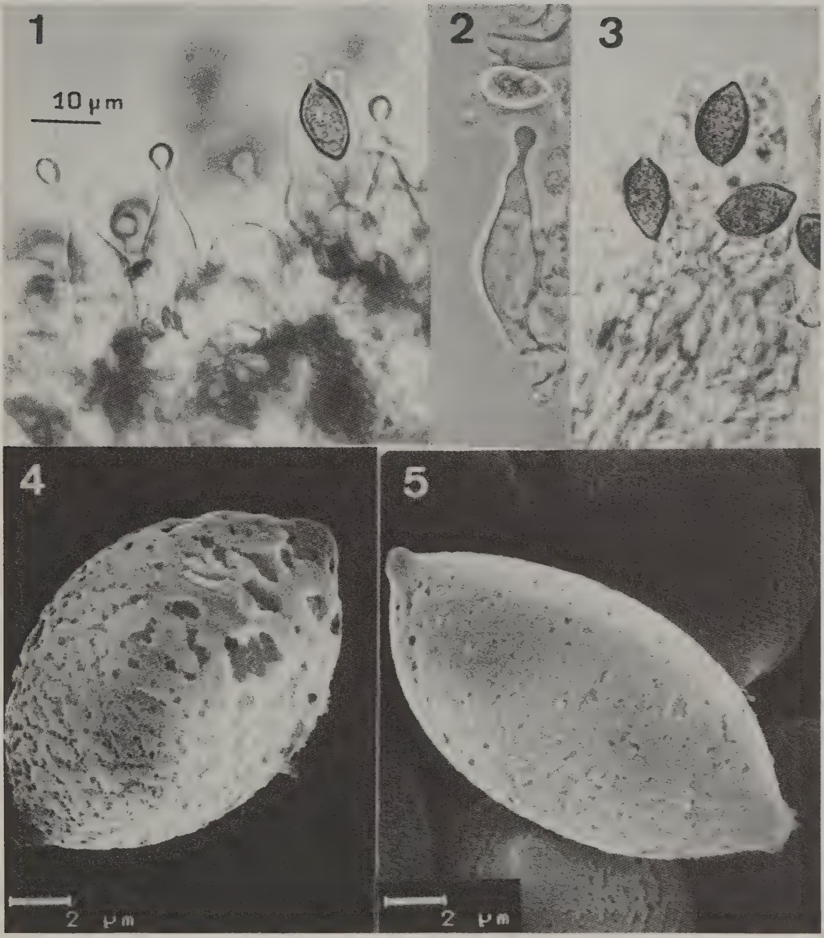

1
10 µm
2
3
4
2 µm
5
2 µm

Fig. 1-5 *Setchelliogaster tenuipes* var. *rheophylla* (AH 18399). 1-2: Cheilocystida. 3-5 Spores.

alignments mentioned in MARTÍN & ROCABRUNA (1999): *Naucoria rheophylla* (AF099361) and *Setchelliogaster tenuipes* (AF099362; AF099363); as well as the following sequences retrieved from the GenBank: *Cortinarius traganus* AF037224; *C. armillatus* AF037223; *Dermocybe subcinnabarina* U56069, *Dermocybe sanguinea* U56060 and *D. semisanguinea* U56067).

SEQAPP software for multiple sequences was used to search for the best alignment. Parsimony and maximum likelihood analyses were performed using the computer program PAUP 4.0b* (SWOFFORD, 1996). Branch robustness was estimated by boostrap analysis (FELSENTEIN, 1985) of 1000 heuristic replicates. Sequences of *Boletus calopus* (AJ296293) and *Boletus lupinus* (AJ296294) obtained in this study were used as outgroups.

RESULTS AND DISCUSSION

Morphology

The characters shared by *Setchelliogaster tenuipes* and *S. rheophyllus* are:

1.- The pileipellis is formed by hymenium-like elements projecting from an underlying layer of isodiametric cells.

2.- The hyphae are fibulate.

3.- The spores are ornamented and do not have a germinative pore (Fig.3-5).

4.- Both species have always been collected under *Eucalyptus*.

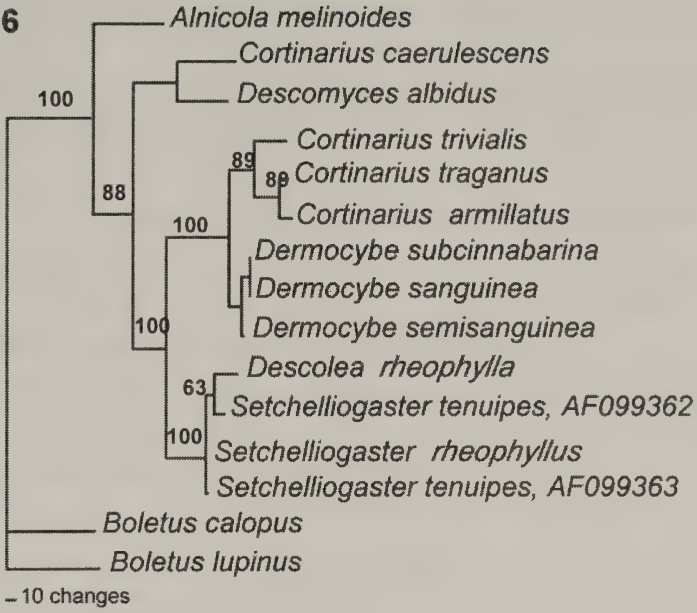
The differences between the taxa are:

1.- The basidiomes of *S. rheophyllus* show visible white-edged gills.

2.- The tibiiform cheilocystidia are abundant in *S. rheophyllus* (Fig. 1-2).

Sequence data.- The alignment from the sequences The alignment files can be accessed through WWW at http://www.ctv.es/USERS/fgfigueres/MariPaz/mpmartin.htm. MP analysis (branch-and-bound search) gave one MPTs with a length of 782 steps, a consistency index (CI) of 0.7596 and a retention index (RI) of 0.6708. Fig. 6 shows the MPTs and Fig. 7 show the ML tree. In both analyses, *Setchelliogaster rheophyllus* (=*Naucoria rheophylla*) and *Setchelliogaster tenuipes* clade together in a very well supported group (100 % bootstrap) between *Cortinarius* and *Dermocybe* sequences. This confirms that both taxa belong to the order Cortinariales. Moreover, the two collections of *Setchelliogaster tenuipes* and the two of *Naucoria rheophylla* do not form two separate clades. These results reinforce the conclusion in

6


Alnicola melinoides
Cortinarius caerulescens
Descomyces albidus
Cortinarius trivialis
Cortinarius traganus
Cortinarius armillatus
Dermocybe subcinnabarina
Dermocybe sanguinea
Dermocybe semisanguinea
Descolea rheophylla
Setchelliogaster tenuipes, AF099362
Setchelliogaster rheophyllus
Setchelliogaster tenuipes, AF099363
Boletus calopus
Boletus lupinus
100
88
89
88
100
100
63
100
10 changes

7

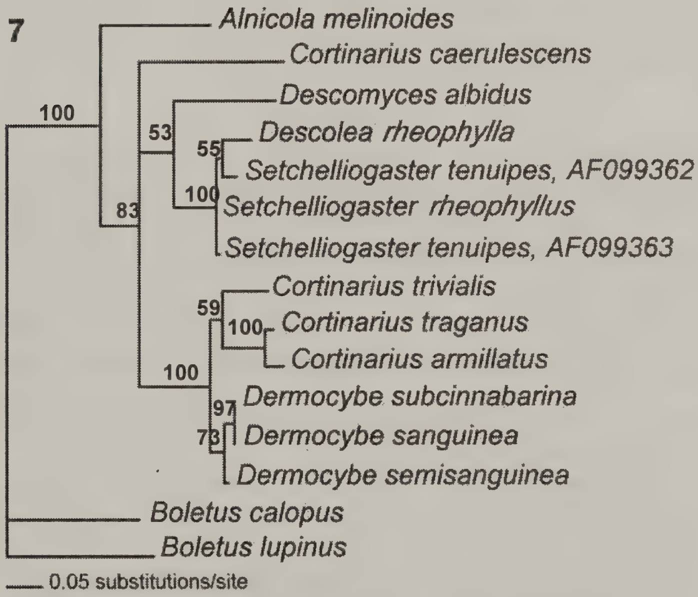

Alnicola melinoides
Cortinarius caerulescens
Descomyces albidus
Descolea rheophylla
Setchelliogaster tenuipes, AF099362
Setchelliogaster rheophyllus
Setchelliogaster tenuipes, AF099363
Cortinarius trivialis
Cortinarius traganus
Cortinarius armillatus
Dermocybe subcinnabarina
Dermocybe sanguinea
Dermocybe semisanguinea
Boletus calopus
Boletus lupinus
100
53
55
100
83
59
100
100
97
73
0.05 substitutions/site

Fig.6 Branch and bound search based on 210 parsimony-informative characters. Percentages from 1000 bootstrap replications are given on the branches. **Fig. 7** The most likely tree found in the maximum likelihood search. Percentages from 1000 bootstrap replications are given on the branches.

Martín & Rocabruna (1999): the two taxa are morphotypes of a single species.

The morphotypes show sufficient macro- and microscopical differences to separate them. We therefore maintain both at variety level.

Setchelliogaster tenuipes (Setch.) Pouzar var. *tenuipes*,

Setchelliogaster tenuipes* var. *rheophylla* (Bertault & Malençon) G. Moreno & M.P. Martín, *comb. nov. et status nov.

≡ *Naucoria rheophylla* Bertault & Malençon *in* Malençon & Bertault, *Flore des Champignons Supérieurs du Maroc* I: 427. 1970.

≡ *Descolea rheophylla* (Bertault & Malençon) Malençon, *Sydowia Beih.* 8: 258. 1979.

≡ *Setchelliogaster rheophyllus* (Bertault & Malençon) G. Moreno & Kreisel, *Feddes Repertorium* 108 (7-8): 567. 1997.

ACKNOWLEGMENTS

This study was supported by an postdoctoral grant from the Comunidad de Madrid to MPM and by the Research Project of the DGICYT PB98-0538-C04-02. We wish to express our gratitude to Dr. M. Glenn (Seton Hall University) for her kind English revision. Sequences were obtained at the Authomatic Sequencing Service (CIB-CSIC, Madrid), thanks to A.A. Diaz, G. Porras and S. Carbajo.

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MYCOTAXON

Volume LXXVIII, pp. 265-326 April-June 2001

TAXONOMICAL STUDIES ON USTILAGINALES. XXI

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Key words: smut fungi, Ustilaginomycetes, new species, new combinations, synonyms, excluded taxon, neotypes, lectotypes.

ABSTRACT

The smut fungi of Amaryllidaceae, those of the grass taxa Aristideae, Chionachninae, Melinidinae, *Acroceras*, *Aristida*, *Arthraxon*, *Chionachne*, *Melinis*, *Paspalidium*, *Polytoca*, *Rhynchelytrum*, *Trichachne*, *Tricholaena* and *Triraphis* have been studied, as well as *Ustilago bullata*, *U. bromivora*, *Conidiosporomyces* and *Tilletia* of *Setaria*, some diverse smut fungi, and the genus *Pseudodoassansia*, which is emended.

NEW SPECIES proposed: *Pseudodoassansia hydrocleydis* (type on *Hydrocleys nymphoides*, Argentina); *Sporisorium coelorachidis* (type on *Coelorachis clarkei*, India); *Sporisorium horsfallii* (type on *Paspalidium rarum*, Australia); *Sporisorium polytocae-digitatae* (type on *Polytoca digitata*, Burma); *Tilletia palpera* (type on *Aristida* sp. and *A. calycina*, Australia); *Tilletia cynodontis* (type on *Cynodon plectostachyus*, Ethiopia); *Tilletia setariae-viridis* (type on *Setaria viridis*, China); *Urocystis alstroemeriae* (type on *Alstroemeria pallida*, Chile); *Urocystis thaxteri* (type on *Hypoxis acuminata*, South Africa); *Ustilago acroceratis* (type on *Acroceras macrum*, Zimbabwe); *Ustilago latzii* (type on *Triraphis mollis*, Australia); *Ustilago triraphidis* (type on *Triraphis schinzii*, Zambia).

NEW COMBINATIONS proposed: *Conidiosporomyces echinospermus*, based on *Tilletia echinosperma* (type on *Setaria sphacelata*);

Macalpinomyces aristidae-cyananthae, based on *Ustilago aristidae-cyananthae* (type on *Aristida-cyanantha*); *Macalpinomyces chrysopogonicola*, based on *Sphacelotheca chrysopogonicola* (type on *Chrysopogon* sp.); *Sporisorium aristidae*, based on *Tolyposporium aristidae* (type on *Aristida cyanantha*); *Sporisorium aristidae-lanuginosae*, based on *Sphacelotheca aristidae-lanuginosae* (type on *Aristida lanuginosa*); *Sporisorium aristidicola*, based on *Ustilago aristidicola* (type on *Aristida* sp.); *Sporisorium confusum*, based on *Sorosporium confusum* (type on *Aristida dichotoma*); *Sporisorium fraserianum*, based on *Sorosporium fraserianum* (type on *Aristida leptopoda*); *Sporisorium goniosporum*, based on *Ustilago goniospora* (type on *Aristida adoensis*); *Sporisorium panici*, based on *Sorosporium panici* (type on ?*Panicum flavidum* = *Paspalidium aversum*); *Sporisorium polytocae*, based on *Ustilago polytocae* (type on *Polytoca barbata*); *Sporisorium polytocae-barbatae*, based on *Ustilago polytocae-barbatae* (type on *Polytoca barbata*); *Tilletia punensis*, based on *Neovossia punensis* (type on *Polytoca barbata*); *Ustilentyloma oreochloae*, based on *Entyloma oreochloae* (type on *Oreochloa disticha*).

SYNONYMS: *Sorosporium arthraxonis* (type on *Arthraxon lanceolatus*) and *Sphacelotheca arthraxonis* (type on *Arthraxon quartinianus*) are identical with *Sporisorium tranzschelianum* (type on *Arthraxon ciliaris*); *Sorosporium consanguineum* var. *bullatum*, and *Sorosporium penuriasorus* are synonyms of *Sporisorium aristidicola*; *Sorosporium maroccanum* (type on misnamed *Brachypodium*) is *Ustilago bromivora* (type on *Bromus secalinus*); *Ustilago aristidicola* (type on misnamed *Paspalum brunneum*) is *Sporisorium microsporum* (type on *Paspalum* sp.); *Ustilago asprellae* (type on misnamed *Elymus scaber*) is *Ustilago bullata* (type on *Elymus scaber*); *Ustilago chrysopogonis* (type on *Chrysopogon gryllus* auct.) is *Macalpinomyces chrysopogonicola* (type on *Chrysopogon* sp.); *Ustilago panici-geminati* (type on *Paspalidium geminatum*) is *Ustilago rickeri* (type on *Paspalidium geminatum*).

EXCLUDED TAXON (forma): *Tilletia echinochloae* f. *foliicola* (type on *Echinochloa crus-galli*) is not a smut fungus.

NEOTYPES are designated for *Ustilago aristidae-cyananthae* (=*Macalpinomyces*) and for *Sorosporium aristidae*.

LECTOTYPES are designated for *Cintractia distichlidis* (= *Ustilago distichlidis*), *Tilletia oklahomae*, *Urocystis aristidicola* (= *Sporisorium aristidicola*), *Urocystis nevodovskyi* and *Ustilago arthraxonis* (= *Sporisorium arthraxonis*).

KEYS are given to the smut fungi of 1. Amaryllidaceae, 2. *Arthraxon*, 3. Melinidinae (*Melinis*, *Rhynchelytrum*, *Tricholaena*), 4. *Triraphis*, 5. Chionachninae (*Chionachne*, *Polytoca*), 6. *Paspalidium*, 7. Aristideae (*Aristida*, *Stipagrostis*), 8. *Conidiosporomyces* and *Tilletia* of *Setaria*, and to 9. the *Ustilentyloma* species.

THE SMUT FUNGI OF AMARYLLIDACEAE, S. LAT.

At least 10 smut fungi have been described from host plants in Amaryllidaceae. Of these, *Tuburcinia javanica* Koorders (1907:196; type on *Hymenocallis* sp. cult., Java, BPI 189131!) was excluded from smut fungi by Ulbrich (1940:78), being a *Stemphylium* sp. (anamorph of *Pleospora*, ascomycetes; see also Vánky, 1991:167). *Ustilago ixiolirii* L. Guo was found to be *Urocystis nevodovsky* Schwarzman (Vánky, 1989:156). A new species was recently collected in Chile on *Alstroemeria* and another one in South Africa on *Hypoxis*. All the recognised 10 smut fungi on Amaryllidaceae belong to the genus *Urocystis*. These are:

1. *Urocystis alstroemeriae* Vánky & C. Vánky, sp. nov.

Typus in matrice *Alstroemeria pallida* Graham (det. M. S. Muñoz, SGO), Chile, 122 km NNE. Santiago de Chile, 42 km E. urbe Los Andes, in alpibus Andes, 32°54'55" S, 70°13'50" W, alt. cca. 1730 m, 14.XII.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 19100, isotypi in BPI, IMI 384513 et in Vánky, Ust. exs. no. 1080.

Sori caulem totum comprendentes, tumefacti, basin versus gradatim, apicem versus abrupte tenuiescentes, 0,5–1,5 x 20–30 cm, maturitate longitudinaliter dehiscentes massam glomerulorum sporarum nigrobrunneam, semiagglutinatam usque pulveream et residua fasciculorum telarum plantae nutrientis ostendentes. *Glomeruli sporarum* globosi, late ellipsoidales vel parum irregulares, raro elongati, 20–35 x 24–50(–60) µm, rufobrunnei, e sporis (0–)1–4(–6) [0=3,5%, 1=30%, 2=40%, 3=16,5%, 4=6%, 5=3%, 6=1%] compositi, cellulis sterilibus complete circumdati. *Sporae* globosae, ovoideae, ellipsoidales usque elongatae, aliquid irregulares, cum lateribus parum deplanatis, 12–16 x 13,5–21 µm, favidulo- usque rubrobrunneae; pariete aequali, 0,5–1 µm crasso, levi. *Cellulae steriles* forma magnitudineque variae, subglobosae, ellipsoidales, elongatae, irregulares, plerumque cum lateribus contactis deplanatis, 5,5–16 x 5,5–20 µm, flavae; pariete inaequaliter crasso, 1–2,5 µm, levi.

Sori (Fig. 1) comprise the whole stem, swollen, gradually narrowing towards the base, abruptly towards the apex, 0.5–1.5 x 20–30 cm, at maturity splitting longitudinally disclosing the blackish-brown, semiagglutinated to powdery mass of spore balls and remnants of irregular fascicles of host tissues. *Spore balls* (Figs. 4, 5) globose, broadly ellipsoidal or slightly irregular, rarely elongated, 20–35 x 24–50(–60) µm, reddish-brown, composed of (0–)1–4(–6) spores [0=3.5%, 1=30%, 2=40%, 3=16.5%, 4=6%, 5=3%, 6=1%], completely surrounded by sterile cells. *Spores* (Fig. 4) globose, ovoid, ellipsoidal to elongated, somewhat irregular with slightly flattened sides, 12–16 x 13.5–21 µm, yellowish- to reddish-brown; wall even, 0.5–1 µm thick, smooth. *Sterile cells* (Figs. 4, 5) variable in shape and size, subglobose, ellipsoidal, elongated, irregular, usually with flattened contact sides, 5.5–16 x 5.5–20 µm, yellow; wall unevenly thick, 1–2.5 µm, smooth.

On Amaryllidaceae (Alstroemeriaceae): *Alstroemeria pallida* Graham; S. America (Chile). Known only from the type collection.

Urocystis alstroemeriae is close to *U. bomareae*. Their host plants, *Alstroemeria* and *Bomarea*, are also closely related and both often placed in a separate family (Alstroemeriaceae). In Engler's Syllabus (1964:520), they are placed in the subfam. Alstroemerioideae of the Liliaceae family. The two smuts, however, differ in the sorus and spore ball characters. The sori of *U. alstroemeriae* comprise the whole stem whereas those of *U. bomareae* are restricted to the distal part of the stems. The 1- and 2-spored balls together represent 70% of all spore balls in *U. alstroemeriae*, those in *U. bomareae* only 54%.

2. *Urocystis bomareae* Dietel & Neger, in Neger, 1896:788.

Tuburcinia bomareae (Dietel & Neger) Liro, 1922:39. – Type on *Bomarea salsilla* Mirb., Chile, Concepción, XI.1896, F. W. Neger. Isotypes in Sydow, Ust. no. 192, HUV 2626! Topotype on XI.1905, coll. R. Thaxter, isotopotypes in Rel. Farlow. no. 949, HUV 2627!

Sori comprise the distal part of the stem, fusiform, 0.3–0.8 x 1.5–6 cm, when mature they split longitudinally disclosing the blackish-brown, semiagglutinated to powdery mass of spore balls and remnants of host tissues. *Spore balls* globose, ellipsoidal, elongated or slightly irregular, 25–40 x 25–50 µm, reddish-brown, composed of (0–)1–4(–6) spores [0=2%, 1=18%, 2=36%, 3=29.5%, 4=11, 5=2%, 6=1.5%], completely surrounded by sterile cells. *Spores* subglobose, ovoid, ellipsoidal to elongated, usually slightly irregular with more or less flattened sides, 10–15 x 13.5–20 µm, yellowish- to reddish-brown; wall even, c. 0.5 µm thick, smooth. *Sterile cells* variable in shape and size, 8–20 µm long, pale yellowish-brown, collapsed in old specimens; wall unevenly thick, 1–2 µm wide.

On *Bomarea salsilla* Mirb.; S. America (Chile). Known only from the type locality.

3. *Urocystis galanthi* H. Pape, 1923:335.

Tuburcinia galanthi (H. Pape) Zillig, in Sorauer, 1932:275. – *Tuburcinia galanthi* (H. Pape) Liro, 1938:173 (superfl. comb.). – Neotype (designated by Vánky, 1990:275) on *Galanthus nivalis* L. (cult.), Germany, Bayern, Dillingen/Donau, garden of the Kapuziner Kloster, 1.V.1987, B. & F. Oberwinkler, A. Nagler, U. & K. Vánky, HUV 13318!, isoneotypes in Vánky, Ust. exs. no. 624.

For description and illustration see Vánky, 1994:292 & 320.

On *Galanthus nivalis* L.; Europe. Very rarely collected.

4. *Urocystis hypoxidis* Thaxter, 1890:156 (as *hypoxys*); 1893:278 (as *hypoxyis*).

Tuburcinia hypoxidis (Thaxter) Liro, 1922:39 (as *hypoxys*). – Type on *Hypoxis erecta* L. (= *H. hirsuta* (L.) Coville), USA, Conn., near New Haven, Westville, VI-VIII, 1889, R. Thaxter. Isotypes in Ellis & Everh., N. Amer. fgi. no. 2688, HUV 9259! Topotype on VI.1891, R. Thaxter, isotopotypes in Rel. Farlow. no. 696, HUV 2781!

Sori in the swollen, deformed capsules, more or less completely destroying the inner parts, often extending to the floral pedicels, when mature they rupture irregularly disclosing the blackish-brown, semiagglutinated to powdery mass of spore balls. *Spore balls* (Fig. 7) globose, ellipsoidal to slightly irregular, 20–45 x 25–60 μm, yellowish-brown, composed of (1–)3–10(–15) spores and a completely investing layer of sterile cells. *Spores* subglobose, ovoid, ellipsoidal, usually slightly irregular with somewhat flattened sides, 9–14 x 11–16(–17) μm, yellowish-brown; wall evenly thick, c. 0.5 μm, smooth. *Sterile cells* variable in shape and size, 7–21 μm long, pale yellowish-brown, partly collapsed in old specimens; wall unevenly thick, 1–5 μm, smooth.

On *Hypoxis aurea* Lour., *H. decumbens* L., and its var. *major* Seub., *H. domingensis* Urb., *H. glabella* R. Br., *H. hirsuta* (L.) Coville (*H. erecta* L.), and *H.* sp.; Asia, Australia, N. & S. America.

5. ***Urocystis ixiolirii*** Zaprometov, 1928:23.

Tuburcinia ixiolirii (Zaprom.) Lavrov, 1937:3. – Type on *Ixiolirion tataricum* Roem. & Schult. (= *I. pallasii* Fisch. & Mey), Taschkent, canal Darhan, 2nd bridge, 30.IV.1920, N. G. Zaprometov, LE!

Sori as pustules in the leaves, 1–2 x 6–10 mm, initially covered by a greyish membrane of host tissue which ruptures at maturity disclosing the semipowdery, dark brown mass of spore balls. *Spore balls* globose, ellipsoidal to slightly irregular, 22–35 x 25–50 μm, composed of 1–2(–3) spores [1=79%, 2=18%, 3=3%], completely surrounded by sterile cells. *Spores* globose, ovoid, ellipsoidal to slightly irregular with flattened sides, 12–16 x 15–20 μm, reddish-brown; wall evenly thick, c. 0.5 μm, smooth. *Sterile cells* irregular, 5–12 μm long, yellow, collapsed in old specimens; wall unevenly thick, 1–2 μm, smooth.

On *Ixiolirion pallasii* Fisch. & Mey (*I. tataricum* Roem. & Schult.; *I. montanum* (Lab.) Herb.); C. & E. Asia.

6. ***Urocystis leucoji*** Bubák, 1912:66.

Tuburcinia leucoji (Bubák) Liro, 1922:39. – Type on *Leucojum vernum* L, Czech Rep., Bohemia, Teplitz, VI.1900, G. Eichler. Isotypes in Petrak, Fgi. Eichleriani no. 1, HUV 2847!

For description and illustration see Vánky, 1994:295 & 326. Morphologically *Urocystis leucoji* is close to *U. galanthi*.

On *Leucojum vernum* L.; Europe. Reported only a few times.

7. ***Urocystis narcissi*** (Gonz. Frag.) Vánky, 1993:41.

Urocystis colchici (Schltdl.) Rabenh. f. *narcissi* González Fragoso, 1914:22. – *Tuburcinia narcissi* (Gonz. Frag.) Ciferri, 1938:101. – Type on *Narcissus* sp., Spain, Mts. Guadarrama, Estación Alpina de Biologia, 25.VI.1914, R. González Fragoso, MA 549!, BPI 178611!

For description see Vánky, 1994:453.

On *Narcissus* sp. Known only from the type locality. According to Prof. Caballero (in González Fragoso, 1914:23), the host plant may be *Narcissus pallidulus* Graells [= *N. triandrus* L. subsp. *pallidulus* (Graells) D. A. Webb], or *N. graellsii* Graells [= *N. bulbocodium* L. subsp. *bulbocodium*].

8. *Urocystis nevodovskyi* Schwarzman, 1960:327.

Lectotype (designated here) on *Ixiolirion tataricum* Roem. & Schult. (= *I. pallasii* Fisch. & Mey), Kazakhstan, Region of Alma-Ata, near the Aksaj River, 23.V.1932, G. Nevodovskij, HUV 10833!, isolectotypes in AA, LE and HUV 12379!

Ustilago ixiolirii L. Guo, 1988:222. – Type on *Ixiolirion tataricum* Roem. & Schult., China, Xinjiang, Yuminxian, 3.VIII.1986, L. Guo, 783. Holotype in HMAS 51934, isotype in HUV 13132!

Sori in the capsules, ovoid-ellipsoidal, 0.4–0.8 x 0.5–1(–1.5) cm, indehiscent, filled with a blackish-brown, powdery mass of spore balls. *Spore balls* globose or ellipsoidal, 12–20 x 13–24(–28) µm, composed of (0–)1(–3) spores [0=0.5%, 1=92%, 2=7%, 3=0,5%], yellowish-brown, completely invested by collapsed sterile cells. *Spores* globose, subglobose, rarely with slightly flattened side, 10–15 x 11–15 µm, yellowish- to reddish-brown; wall evenly thick, c. 0.5 µm. *Sterile cells* irregular, thin-walled (c. 0.5 µm), collapsed, 1–3 µm high, giving a typical, cerebriform aspect to the "spore surface".

On *Ixiolirion pallasii* Fisch. & Mey (*I. tataricum* Roem. & Schult.); C. & E. Asia.

9. *Urocystis sternbergiae* Moesz, 1921:61.

Tuburcinia sternbergiae (Moesz) Gutner, 1941:296. – Type on *Sternbergia colchiciflora* Waldst. & Kit., Hungary, Budapest, Mt. Állatkert hegy, Hüvösvölgy valley, 15.V.1912, G. Moesz. Holotype in BP!, isotype in HUV 3040!

For description and illustration see Vánky, 1994:305 & 338.

On *Sternbergia colchiciflora* Waldst. & Kit.; S.-E. Europe (Hungary, Romania, Yugoslavia).

10. *Urocystis thaxteri* Vánky, **sp. nov.**

Typus in matrice *Hypoxis acuminata* Baker, South Africa, Orange Free State Prov., Golden Gate Highlands National Park, cca. 25 km E. oppid. Clarens, 28°30'35" S, 28°38'04" E, alt. cca. 2020 m, 28.XII.1996, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 18403, isotypi in Vánky, Ust. exs. no. 1039 (sub *Urocystis hypoxis*). Paratypi in matrice *Hypoxis costata* Baker, South Africa, Transvaal Prov., Pretoria Distr., Irene, 1.III.1927, leg. I. B. Pole-Evans, PREM 21108, HUV 18188!; in matrice *Hypoxis galpinii* Baker, South Africa, KwaZulu-Natal Prov., 9 km N. oppid. Mooiriver, 29°08'18" S, 29°59'38" E, alt. cca. 1570 m, 1.I.1997, leg. C. & K. Vánky, HUV 18436!, isoparatypi in Vánky, Ust. exs. no. 1040 (sub *Urocystis hypoxis*); et in matrice *Hypoxis rigidula* Baker, South Africa, KwaZulu-Natal Prov., The Swamp Nature Reserve, 2 km N. oppid. Pevensey, 29°45'50" S, 29°37'06" E, alt. cca. 1550 m, 8.I.1997, leg. C. & K. Vánky, HUV 18437!, PREM.

Urocystis thaxteri ab *U. hypoxide* Thaxter (J. Mycol. 7:153, 1890) praesertim magnitudine glomerulorum sporarum et numero sporarum glomerulorum distinctus. Glomeruli sporarum *U. thaxteri* 30–50 x 35–70(–80) µm magni et e sporis (3–)5–25(vel plus?) compositi, sed glomeruli sporarum *U. hypoxidis* 20–45 x 25–60 µm, et e sporis (1–)3–10(–15) compositi.

Sori (Fig. 2A) as in *Urocystis hypoxidis* Thaxter, in the capsules and often also in floral pedicels, when mature they rupture irregularly disclosing the blackish-brown, semiagglutinated to powdery mass of spore balls. *Spore balls* (Fig. 6) globose, ovoid, ellipsoidal, elongated to slightly irregular, 30–50 x 35–70(–80) µm, reddish-brown, composed of (3–)5–25(–or more?) spores and a completely investing layer of sterile cells. *Spores* (Fig. 6) subglobose, ovoid, ellipsoidal or elongated, usually slightly irregular with flattened sides, (9.5–)11–14(–15) x 13.5–17 µm, reddish-brown; wall evenly thick, c. 0.5 µm, smooth. *Spore germination* (Fig. 2B) results in short holobasidia with 4–8 ovoid basidiospores. *Sterile cells* (Fig. 6) variable in shape and size, 7–21 µm long, pale yellowish-brown, collapsed in old specimens; wall unevenly thick, 1–5 µm, smooth.

On *Hypoxis acuminata* Baker, *H. costata* Baker, *H. galpinii* Baker, *H. rigidula* Baker. Known hitherto only from S. Africa.

Urocystis thaxteri differs from *U. hypoxidis* Thaxter especially in the size of the spore balls and in the number of the spores in a ball. In *U. thaxteri* the spore balls measure 30–50 x 35–70(–80) µm and are composed of (3–)5–25(or more?) spores whereas in *U. hypoxidis* (Fig. 7) these measure 20–45 x 25–60 µm and are composed of (1–)3–10(–15) spores.

Etymology: *Urocystis thaxteri* is named in honour of Roland Thaxter (1858–1932), one of the greatest North American mycologists with outstanding artistic talent, who also described *U. hypoxidis*, to which *U. thaxteri* is similar in appearance.

Key to the smut fungi (*Urocystis*) of Amaryllidaceae

1. Sori in the capsules 2
– Sori elsewhere 5
2. Sori only in the capsules, indehiscent. Spore balls appear as cerebriform spores. On *Ixiolirion* .... *U. nevodovskyi*
– Sori in the capsules, and also in other parts of the host plant, dehiscent. Spore balls do not appear as cerebriform spores. 3
3. Sori also on the leaves as pustules. On *Sternbergia* .... *U. sternbergiae*
– Sori also on the floral pedicels. On *Hypoxis* 4
4. Spore balls of (1–)3–10(–15) spores .... *U. hypoxidis*
– Spore balls of (3–)5–25(–or more?) spores .... *U. thaxteri*
5. Sori in the stems as fusiform swelling 6
– Sori on the leaves as pustules 7
6. Sori comprise the whole stem. On *Alstroemeria* .... *U. alstroemeriae*
– Sori on the distal part of the stem. On *Bomarea* .... *U. bomareae*
7. Sori only on the leaves 8
– Sori also in the capsules. On *Sternbergia* .... *U. sternbergiae*
8. Spore balls of 1, rarely 2 spores. On *Leucojum* .... *U. leucoji*
– Spore balls of more spores 9
9. Spore balls of 1–2(–3) spores. On *Ixiolirion* .... *U. ixiolirii*
– Spore balls of 1–3(–4) spores 10
10. Spores 16.5–23.5 µm long. On *Galanthus* .... *U. galanthi*
– Spores 13–20 µm long. On *Narcissus* .... *U. narcissi*

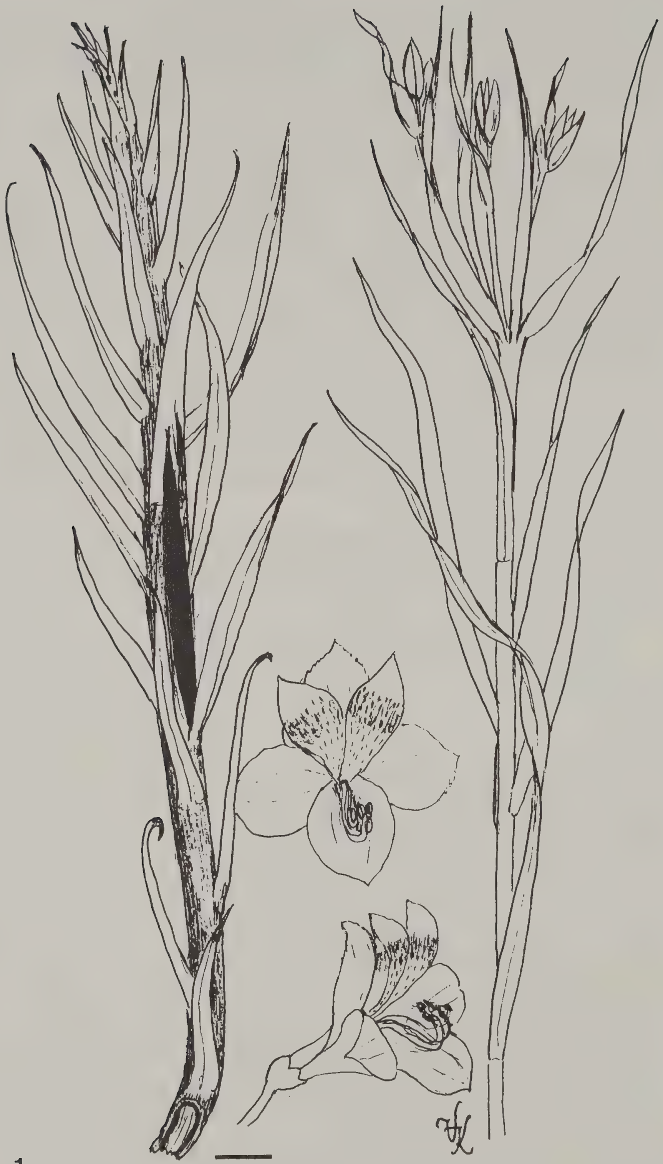

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Fig. 1. Sori of *Urocystis alstroemeriae* Vánky & C. Vánky in the swollen stem of *Alstroemeria pallida* Graham (type). To the right a healthy stem with buds, in the middle two flowers. Bar = 1 cm.

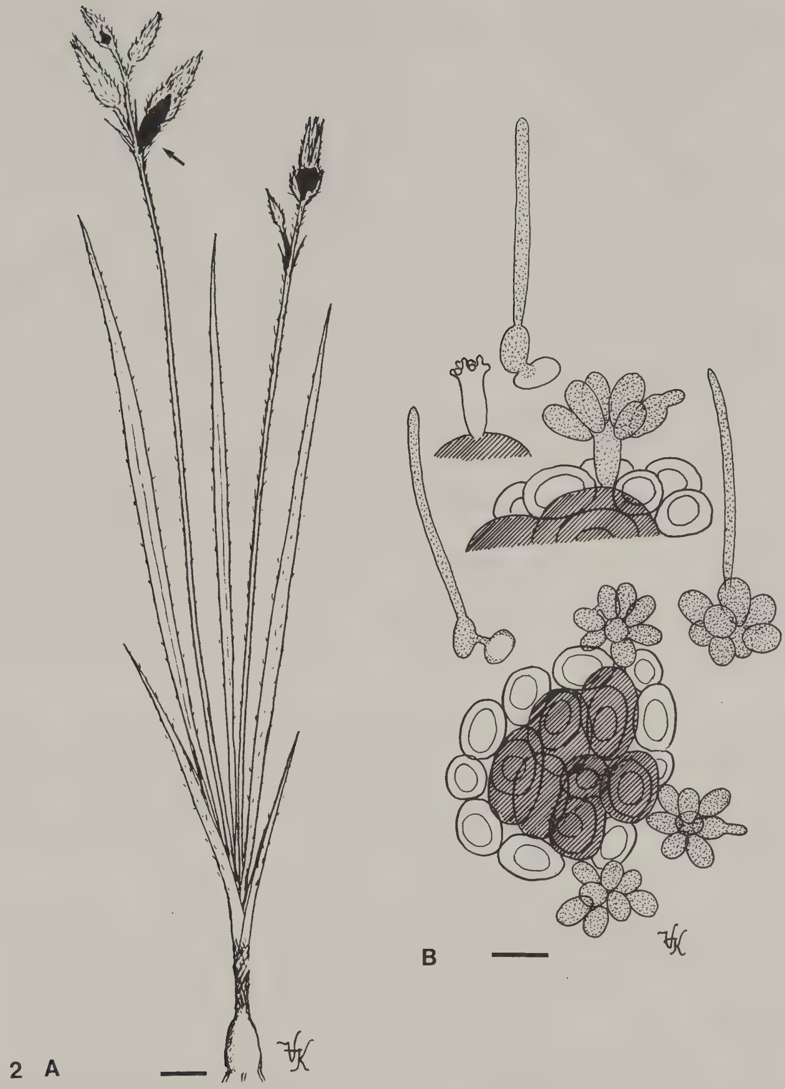

Fig. 2. *Urocystis thaxteri* Vánky on *Hypoxis acuminata* Baker (type).
A. Sori in the capsules and also in a floral pedicel (arrow) Bar = 1 cm.
B. Germinating spores (on WA, at room temp., in 3 days) Bar = 10 µm.

THE EMENDED GENUS *PSEUDODOASSANSIA* (DOASSANSIACEAE)

Setchell (1891:16) described *Doassansia* Cornu subgen. *Pseudodoassansia* Setch. which was raised to generic level as *Pseudodoassansia* (Setch.) Vánky (1981:174), a unispecific genus (comp. Vánky, 1987:92). In the new classificatory system of the smut fungi (Bauer et al., 1997, Vánky, 1999a), *Pseudodoassansia* belongs to the Doassansiaceae (Azbukina & Karatygin) R. T. Moore, emend R. Bauer & Oberw., of the Doassansiales R. Bauer & Oberw.

Recently, a smut fungus was collected in Argentina on *Hydrocleys nymphoides* (Limnocharitaceae), forming spore balls somewhat resembling those of *Pseudodoassansia obscura* (Setch.) Vánky, the type of the genus. At the same time, it is different from the spore ball structure of all the other ten related genera (comp. Vánky, 1999b). To classify this new species, I prefer to alter the characterisation of *Pseudodoassansia*, instead of describing a new genus.

Pseudodoassansia (Setch.) Vánky, 1981:174, **emend**. Vánky
Doassansia Cornu subgen. *Pseudodoassansia* Setchell, 1891:16.

Sori forming spots with spore balls embedded in the host tissues of aquatic or paludal plants. *Spore balls* rather permanent, composed of a cortex of sterile cells and a network of branched hyphae in which the spores are scattered irregularly or concentrated towards the periphery of the balls. *Spores* light coloured (subhyaline or pale yellowish-brown). Germination of *Tilletia*-type. *Host–parasite interaction* by complex interaction apparatus with pieces of cytoplasm, haustoria absent. *Septal pore* is simple, with two membrane caps. Typus generis:

Pseudodoassansia obscura (Setch.) Vánky, 1981:175.
Lectotype (designated by Vánky, 1981:175) on *Sagittaria variabilis* Engelm. (= *S. latifolia* Willd.), USA, Massachusetts, Cambridge, IX.1890, W. A. Setchell, BPI 0178468! Isolectotypes in DAOM, H, HMAS, HUV 9072!, PC.

For detailed description and illustration see Vánky, 1981:175, Fig. 2E, 3H, and 1987:92-93.

Pseudodoassansia hydrocleydis Vánky, **sp. nov.**
Typus in matrice *Hydrocleys nymphoides* (Willd.) Buchenau (det. M. E. Múlgura, SI), Argentina, Prov. Corrientes, 52 km SW. oppid. Paso de Los Libres, 29°52'38" S, 57°32'04" W, alt. cca. 140 m, 27.XI.1999, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 19142, isotypi in LPS et in Vánky, Ust. exs. no. 1079.

Sori ad folia maculas rotundas, 2–7 mm diametro, vel coalescentes majores, atrobrunneas, ad latera adaxiala (supera) acute terminatas, ad latera abaxiala foliorum natantium pallide brunneas, margine indistinctas formantes, cum glomerulis sporarum in telis foliorum demissis sicut punctis multis minutis, pallide flavidobrunneis. Sori vetusti saepe perforati. *Glomeruli sporarum* globosi, ellipsoidales, parum irregulares usque elongati, 50–100(–130) x 50–130(–160) µm, e cortice cellularum sterilium et e reticulo hypharum septatarum, ramosarum, sporis irregulariter dispersis instructo compositi. *Sporae* globosae, subglobosae, ovoideae, ellipsoidales vel parum irregulares, lateribus contactis breviter depressis, 7–10,5 x 8–12 µm, subhyalinae; pariete aequaliter crasso, cca. 0,5 µm, levi. *Cellulae steriles* corticis forma et magnitudine variae, globosae, ovoideae, plerumque irregulares, 4–9 x 4–13 µm, subhyalinae, saepe cum hypha aliqua conjunctae; pariete 0,5–1 µm crasso, levi. *Cellulae hypharum* forma et latitudine variae, cylindricae usque plerumque irregulares, 1–2,5 µm latae, pallide flavae; pariete aequaliter crasso, cca. 0,5 µm, levi.

Sori (Fig. 3) on the leaves forming rounded spots, 2–7 mm in diameter, or larger by confluence, dark brown, sharply delimited on the adaxial, upper side, pale brown, with indistinct margins on the abaxial side of the floating leaves, with spore balls embedded in the leaf tissue as numerous, minute, pale yellowish-brown dots. Old sori are often perforated. *Spore balls* globose, ellipsoidal, slightly irregular to elongated, 50–100(–130) x 50–130(–160) µm, composed of a network of septate, branched hyphae in which the spores are scattered irregularly, and of a cortex of sterile cells. *Spores* (Fig. 8) globose, subglobose, ovoid, ellipsoidal or somewhat irregular by slightly flattened contact sides, 7–10.5 x 8–12 µm, subhyaline; wall evenly thick, c. 0.5 µm, smooth. *Sterile cells* (Fig. 8) of the cortex variable in shape and size, globose, ovoid, usually irregular, 4–9 x 4–13 µm, subhyaline, often connected to a hypha; wall 0.5–1 µm thick, smooth. *Cells of the hyphae* variable in shape and width, cylindrical to usually irregular, 1–2.5 µm wide, pale yellow; wall evenly thick, c. 0.5 µm, smooth.

On Limnocharitaceae: *Hydrocleys nymphoides* (Willd.) Buchenau; S. America (Argentina). Known only from the type collection.

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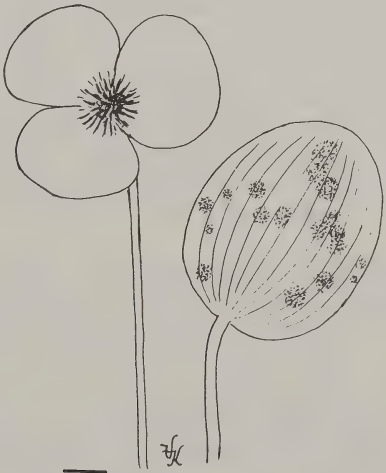


Fig. 3. Sori of *Pseudodoassansia hydrocleydis* Vánky on a leaf of *Hydrocleys nymphoides* (Willd.) Buchenau (type). Within the rounded leaf spots the spore balls embedded in the host tissue appear as minute dots. Bar = 1 cm.

There is disagreement in the literature as to whether *Hydrocleys* belongs to the Alismataceae, Butomaceae or Limnocharitaceae. According to P. Maas (U) the best place for it is in the Limnocharitaceae. In the Index Nominum Genericorum it is still under the Butomaceae, but this will be changed (Dr. G. Zijlstra, U, in litt.). *Pseudodoassansia hydrocleydis* differs from all known smut fungi of Alismataceae, Butomaceae and Limnocharitaceae.

THE SMUT FUNGI OF *ARTHRAXON* (GRAMINEAE)

Arthraxon P. Beauv. is a homogenous genus with about 10 species in Old World tropics, but mainly in India. It belongs to the subtribe Andropogoninae, tribe Andropogoneae of the Paniceae subfamily (Clayton & Renvoize, 1986:353). Five smut fungi have been described on *Arthraxon*. I found that *Sorosporium arthraxonis* S. Ahmad and *Sphacelotheca arthraxonis* Mishra are identical with *Sporisorium tranzschelianum* (Lavrov) Karatygin. The three recognised species are:

1. "*Melanotaenium*" *arthraxonis* (Thirum. & Pavgi) Vánky, 1997b:144.

Melanotaenium brachiariae Viégas var. *arthraxonis* Thirumalachar & Pavgi, 1953:101. — Type on *Arthraxon* sp., India, Bihar, Parasnath, 14.XII.1952, H. C. Govindu, HCIO 20996!

For its description see Vánky, 1997b:144.

On *Arthraxon* sp.; S. Asia (India).

In the new classificatory system of the Ustilaginomycetes "*Melanotaenium*" and "*Entyloma*" species on members of Gramineae and Cyperaceae producing black sori on leaves do not belong to these genera. They belong to the Ord. Georgefischeriales R. Bauer, Begerow & Oberw. (Bauer, Oberwinkler & Vánky, 1997; Vánky, 1999a). However, knowledge of the type of germination (holobasidia with terminal basidiospores or phragmobasidia with lateral basidiospores, both with or without ballistospores) and/or molecular data are necessary to assign these species to one of the four genera of the three families of the Georgefischeriales (unpublished data).

2. *Sporisorium arthraxonis* (Pat.) L. Guo, 1989:221.

Ustilago arthraxonis Patouillard, 1897:346. — *Sphacelotheca arthraxonis* (Pat.) Zundel, 1953:140. — Lectotype (designated here) on *Arthraxon* sp., Vietnam (French Indo China), Tonkin, Thanh Hoa, 21.I.1893, P. H. F. Bon 5844, GH!

Sori in the spikelets, protected by the glumes, 1–2 mm long, initially covered by a whitish to brown peridium which ruptures irregularly disclosing the blackish-brown, powdery mass of spores intermixed with groups of sterile cells. *Spores* when mature single, globose, subglobose, ovoid to ellipsoidal, 10–13 x 11–14(–15) µm, reddish-brown; wall evenly thick (c. 1 µm), finely, densely echinulate; spore profile finely serrulate. *Sterile cells* in small, irregular groups or chains, hyaline to pale yellow, single cells 9-20 µm long, collapsed when old.

On *Arthraxon* sp.; S-E. Asia (Vietnam).

3. *Sporisorium tranzschelianum* (Lavrov) Karatygin, in Karatygin & Azbukina, 1989:81.

Sorosporium tranzschelianum Lavrov, 1936:32. — Type on *Arthraxon ciliaris* P. Beauv. var. *langsdorffii* (Trin.) Hackel (= *Arthraxon langsdorffii* (Trin.) Roshev.), Russia, Far East Region, Vladivostok area, Suifun Distr., valley of the Suifun River, Krivoi spring, affluent of the Suputinka River, 11.VII.1929, V. Tranzschel (as "*Ustilago arthraxonis* n. sp.", nom. herb.), LE 62389!

Sorosporium arthraxonis S. Ahmad, 1956:10. — Type on *Arthraxon lanceolatus* (Roxb.) Hochst., Pakistan, Murree, VIII.1952, S. Ahmad 4783, IMI 57435!

Sphacelotheca arthraxonis Mishra, 1957:259 (later homonym, not (Pat.) Zundel, 1953). — Type on *Arthraxon quartinianus* (Retz.) Kunth, India, Bihar, Netarhat, 3500 ft, J. N. Mishra. Holotype in HCIO 25277, isotypes in HUV 14906! and in IMI 68187.

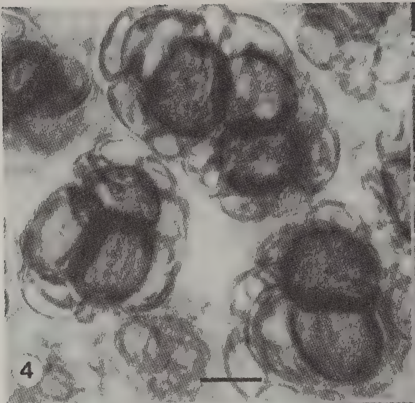
Sori entirely destroying the inflorescence, long cylindrical, c. 1 x 10–20 mm, more or less enclosed by the uppermost leaf sheath, initially covered by a greyish-brown peridium which ruptures irregularly from its apex exposing the blackish-brown, semiagglutinated to powdery mass of spore balls, spores and sterile cells surrounding a central, flagelliform or in its distal part bifurcate columella. *Spore balls* subglobose, ovoid, oblong to irregular, 30–50 x 30–80 µm, reddish-brown, composed of 10–50(or more?) easily separating spores. *Spores* subglobose, ellipsoidal, ovoid or subpolyhedrally irregular, 10–13.5 x 11–14(–16) µm, yellowish-brown; wall slightly unevenly thick (0.5–1 µm), finely, densely verrucose-echinulate; spore profile finely serrulate. *Sterile cells* in short chains or in small, irregular groups, single cells irregular, with flattened contact sides, 7–15 µm long, hyaline, collapsed in old specimens, wall thin (c. 0.4 µm), smooth.

On *Arthraxon ciliaris* P. Beauv., *A. hispidus* (Thunb.) Makino, *A. lanceolatus* (Roxb.) Hochst., *A. lancifolius* (Trin.) Hochst., *A. langsdorffii* (Trin.) Roshev. (*A. ciliaris* P. Beauv. var. *langsdorffii* (Trin.) Hackel), *A. quartinianus* (A. Rich.) Nash; S. & E. Asia (China, India, Pakistan, Russia), Indonesia (Sumatra), Australasia (Papua New Guinea).

Small variations in the spore size may occur but no essential differences could be found between the types of *Sporisorium tranzschelianum* (Lavrov) Karatygin, *Sphacelotheca arthraxonis* Mishra, and *Sorosporium arthraxonis* S. Ahmad, hence the synonymy above.

Key to the smut fungi of *Arthraxon*

1. Sori in the leaves as black spots. Spores embedded in the host tissue, not powdery .... "*Melanotaenium*" *arthraxonis*
– Sori not in the leaves. Spores powdery 2
2. Sori in the spikelets, 1–2 mm long .... *Sporisorium arthraxonis*
– Sori in the whole inflorescence, 1–2 cm long....... *Sporisorium tranzschelianum*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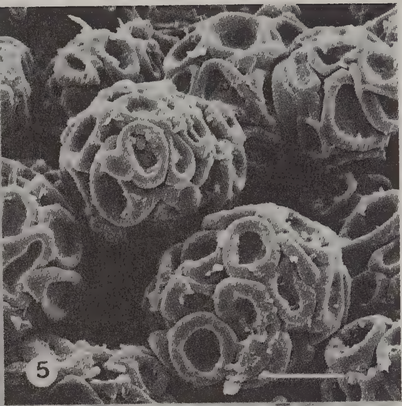
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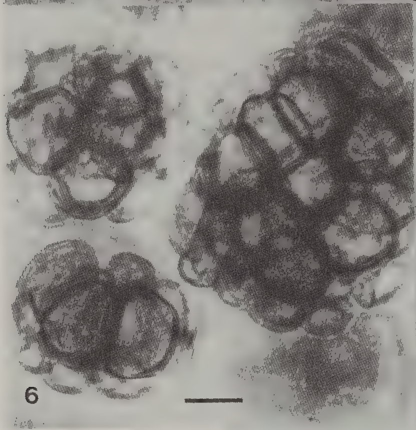
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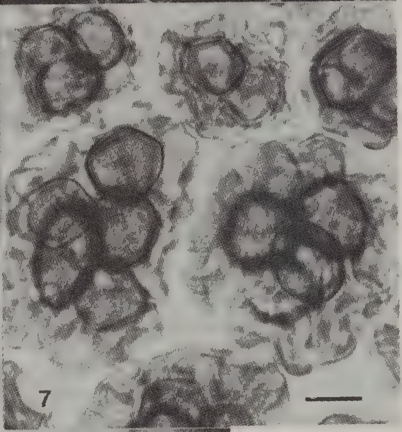
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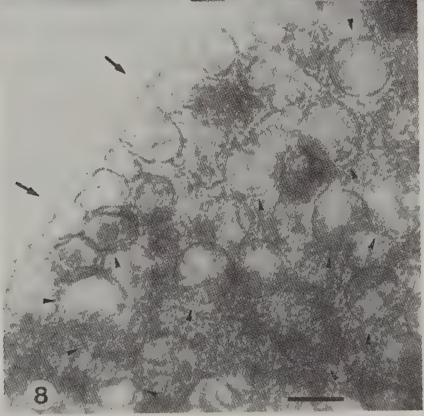
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THE SMUT FUNGI OF MELINIDINAE (GRAMINEAE)

The subtribe Melinidinae (tribe Paniceae, subfam. Panicoideae) is a "close-knit" group of four genera: *Tricholaena* Schult., *Mildbraediochloa* Butzin, *Melinis* P. Beauv., and *Rhynchelytrum* Nees, comprising c. 30 species (Clayton & Renvoize, 1986:294-295). *Rhynchelytrum* and *Melinis* are considered by some authors to be one genus, *Melinis*. The close relationship and many of synonymous names of these 30 plants is a motivation to treat their smut fungi together. At least 9 smut fungi have been published on members of the Melinidinae (comp. Vánky, 1997a:141-142; 2000:197-200). The host plant of "*Sorosporium*" *argentinum* Speg. was originally given as "*Tricholaena insularis*". Actually, it is *Panicum urvilleanum* Kunth (Spegazzini, 1925:151). The recognised 6, or perhaps 7 species are:

1. ***Entyloma farisii*** Ciferri, 1928:11.

Type on *Tricholaena rosea* Nees (= *Melinis repens* (Willd.) Zizka), Dominican Republic, Haina, 1920 (?), J. Faris.

Sori in the leaves as subpustular, round, irregularly round, subelongate to elongate, isolated or confluent spots, 1.5–2 mm in diameter or longer, colourless, dry, indefinite. *Spores* more or less regular, globose to ellipsoidal, 9.5–14.5 μm in diameter, hyaline to very pale olivaceous-green; wall c. 1 μm thick, smooth.

On *Melinis repens* (Willd.) Zizka (*Rhynchelytrum roseum* (Nees) Stapf & C. E. Hubb. ex Bews, *Tricholaena rosea* Nees); West Indies (Dominican Republic). Known only from the type locality.

It is not known to me where the type is deposited. It is not in BPI, where Ciferri's collection is preserved. Description is taken from the original. Judged from the description, *Entyloma farisii* may represent a *Ustilentyloma*.

2. ***Sporisorium melinis*** (Zundel) Vánky, 1997a:141.

Cintractia melinis Zundel, 1938:302. — Type on *Melinis tenuinervis* (Stapf) Stapf (= *M. minutiflora* P. Beauv.), South Africa, Cape Town, 12.VI.1914, C. W. Malley. Holotype in PREM 19860!, isotypes in BPI 141632, 171971!

Ustilago rhynchelytri L. Ling, 1953b:153. — Type on *Rhynchelytrum repens*

Figs. 4, 5. Spore balls, spores and sterile cells of *Urocystis alstroemeriae* Vánky & C. Vánky on *Alstroemeria pallida* Graham, in LM and in SEM (type).

Fig. 6. Spore balls, spores and sterile cells of *Urocystis thaxteri* Vánky on *Hypoxis acuminata* Baker, in LM (type).

Fig. 7. Spore balls, spores and sterile cells of *Urocystis hypoxidis* Thaxter on *Hypoxis hirsuta* (L.) Coville, in LM (type).

Fig. 8. Part of a spore ball of *Pseudodoassansia hydrocleydis* Vánky on *Hydrocleys nymphoides* (Willd.) Buchenau (type), composed of a cortex of empty, sterile cells (arrows) and spores (arrowheads) scattered in a network of hyphae (Hand-section in lactophenol with cotton blue). Bars = 10 μm.

(Willd.) C. E. Hubb. (= *Melinis repens* (Willd.) Zizka), Nyasaland [= Malawi], Lilongwe, 5.IV.1951, G. Jackson. Holotype in IMI 49714!, isotype in BPI 166085!

For detailed description see Vánky, 1997a:141.

On *Melinis minutiflora* P. Beauv. (*M. tenuinervis* (Stapf) Stapf), *M. nerviglumis* (Franch.) Zizka, *M. repens* (Willd.) Zizka subsp. *repens* (*Rhynchelytrum repens* (Willd.) C. E. Hubb.); C. & S. Africa, Australia.

Some collections differ in the coarseness of the spore ornamentation. Those on *M. nerviglumis* have finely punctate-verruculose, not finely echinulate spores, and further studies, based on more specimens, may show that these represent a different taxon.

3. ***Sporisorium monachnes*** Vánky & C. Vánky, in Vánky, 2000:198.

Type on *Tricholaena monachne* (Trin.) Stapf & C. E. Hubb., Zimbabwe, Manicaland Prov., c. 70 km S. Mutare, alt. c. 730 m., 26.II.1999, C. & K. Vánky. Holotype in HUV 18877!, isotypi in BPI, IMI 380466 and in S.

For description and illustration see Vánky, 2000:198.

On *Tricholaena monachne* (Trin.) Stapf & C. E. Hubb.; S. Africa. Known only from the type collection.

4. ***Sporisorium rhynchelytri*** Durán, 1987:117.

Type on *Rhynchelytrum roseum* (Nees) Stapf & C. E. Hubb. (= *Melinis repens* (Willd.) Zizka), Mexico. Holotype in WSP 67742, isotype in HUV 14412!

For description and illustration see Durán, 1987:117 & 121.

On *Melinis repens* (Willd.) Zizka (*Rhynchelytrum roseum* (Nees) Stapf & C. E. Hubb.); N. America (Mexico). Known only from the type collection.

5. ***Sporisorium tricholaenae*** (Henn.) Vánky, 1988b:367.

Ustilago tricholaenae Hennings, 1893:114. — *Sphacelotheca tricholaenae* (Henn.) Mundkur, 1944:51. — Type on *Tricholaena teneriffae* (L. fil.) Link; N. Africa (Egypt).

For detailed description see Vánky, 1988b:370.

On *Melinis nerviglumis* (Franch.) Zizka (*Rhynchelytrum nerviglume* (Franch.) Chiov., *R. nyassanum* (Mez.) Stapf & C. E. Hubb.), *M. repens* (Willd.) Zizka (*Rhynchelytrum roseum* (Nees) Stapf & C. E. Hubb.), *Tricholaena teneriffae* (L. fil.) Link (*Panicum teneriffae* (L. fil.) R. Br.); S. Europe, Africa, S. & SW. Asia.

6. ***Ustilago delicata*** L. Ling, 1953b:153 (as "*delicatus*").

Type on "*Tricholaena delicatula* Stapf & C. E. Hubb." = misnamed *Melinis nerviglumis* (Franch.) Zizka, teste K. Vánky, confirmed by L. Pauwels, BR), Rep. Congo, Gungu Prov., Nyungu, I.1914, H. Vanderyst 3230. Holotype in BR 1313! (as "*Ustilago tricholaena* Henn. var. *congoensis* Beeli", nom. herb.). Paratype on "*Tricholaena delicatula*" = misnamed *Melinis repens* (Willd.) Zizka, teste K. Vánky; or perhaps *M. nerviglumis*, teste L. Pauwels, BR), Rep. Congo, Gungu Prov., Taka, I.1914, H. Vanderyst 3382, BR 1314!

Sphacelotheca tricholaenae (Henn.) Mundk. var. *congoensis* Zambettakis, 1979(1980):412 (nomen invalidum). On *Tricholaena congoensis* Franch., Congo.

Sori destroying the spikelets, transforming them into a blackish-brown, powdery mass of spores intermixed with a few sterile cells, leaving the distal part of the floral envelope with its long hairs intact. The sori are initially covered by the host epidermis which early flakes away. No peridium, no columella. *Spores* variable in shape and size, globose, ovoid, elongated to slightly irregular, 5.5–8.5 x 6–10 µm, yellowish-brown; wall evenly thick, c. 0.5 µm, apparently smooth to very finely punctate. *Sterile cells* larger than the spores, 8–16 µm long, single or in small, irregular groups or short chains, subhyaline to pale yellow, collapsed in old specimens; wall 0.5–1 µm thick, smooth.

On *Melinis nerviglumis* (Franch.) Zizka (*Tricholaena congoensis* Franch.), and ? *M. repens* (Willd.) Zizka; C. Africa (Rep. Congo).

Presence of sterile cells between the spores is a character of *Sporisorium* rather than of *Ustilago*. However, U. *delicata* shows more characters of a *Ustilago* than of a *Sporisorium*.

? ***Ustilago trichophora*** (Link) Körnicke, 1877:36.

Type on *Echinochloa colonum* (L.) Link, Egypt.

For detailed description and illustration see Vánky, 1994:382 & 441.

On *Echinochloa* spp.; World-wide.

According to Zundel (1953:211), *U. trichophora* also occurs on *Tricholaena teneriffae* L. fil. (*Panicum teneriffae* (L. fil.) R. Br.) and *Sacciolepis striata* (L.) Nash (*Panicum fluitans* Brickell). These data have yet to be verified.

Key to the smut fungi of Melinidinae (*Melinis*, *Rhynchelytrum*, *Tricholaena*)

1. Sori on leaves as spots. Spores embedded in the host tissue..... *Entyloma farisii*
– Sori elsewhere. Spores powdery 2
2. Sori in some of the spikelets, on the leaves and stems, forming up to several cm long, hispid swellings .... *Ustilago trichophora*(?)
– Sori in all spikelets or in the whole inflorescence, not hispid 3
3. Sori replacing the whole inflorescence, flagelliform, several cm long.......................... *Sporisorium rhynchelytri*
– Sori in the spikelets, less than 1 cm long.. 4
4. Spores 6–11(–12) µm long.. 5
– Spores 9–14(–16) µm long.. 6
5. Peridium and columella present. Spores 7–11(–12) µm long, punctate to verruculose-echinulate .... *Sporisorium tricholaenae*
– Peridium and columella lacking. Spores 6–10 µm long, apparently smooth to minutely punctate.............................. *Ustilago delicata*
6. Spores subpolyhedrally irregular, 9.5–13 µm long, reddish-brown, finely punctate to verruculose-echinulate. Outer and inner spores in a ball different .... *Sporisorium monachnes*
– Spores broadly ellipsoidal to elongate, 9–14(–16) µm long, yellowish-brown, finely punctate-verruculose to echinulate, all alike............ *Sporisorium melinis*

TWO NEW SMUT FUNGI ON *TRIRAPHIS* (GRAMINEAE)

Triraphis R. Br., with 7 species, 6 in Africa and Arabia, 1 species in Australia, belongs to the subfamily Chlorioideae, tribe Eragrostideae, subtribe Eleusininae (Clayton & Renvoize, 1986:205). To date no smut fungus has been reported on *Triraphis*. Between unidentified smut fungi in Herb. IMI, there is a collection on "*Aristida adscensionis*". The host plant has since been identified as *Triraphis schinzii* Hackel, and its smut fungus turned out to be a new species.

Ustilago triraphidis Vánky, sp. nov.

Typus in matrice *Triraphis schinzii* Hackel (det. H. Scholz, B, and S. Kativu, CAH), Zambia, Southern Province, Nkala, inter pagg. Namwala et Ngoma, prope Kafu National Park, 18.IV.1960, leg. B. L. Mitchell (sicut "smut on *Aristida adscensionis*). Holotypus in IMI 89818! (ex Plant Pathology Herbarium, Northern Rhodesia no. 3582), isotypus in Herbario Ustil. Vánky, HUV 18966!

Sori in ovariis omnibus eiusdem inflorescentiae, saepe etiam organis internis floralibus inclusis, ovoidei usque longe ellipsoidales, apiculati, 0,5–1 x 1,5–3 mm, colore lividi, membrana tenui, argentea, origine hostali, cooperti, qua irregulariter rupta massam sporarum nigrescenti-brunneam, pulveream ostendentes. In soris columella nulla, cellulae steriles inter spora nullae. *Sporae* et magnitudine et forma variae, subglobosae, ellipsoidales, elongatae, subpolyedrice irregulares, raro apiculatae, 6,5–9,5(–10,5) x 8–13(–14,5) µm, rufobrunneae; pariete aequali usque parum inaequaliter 0,5–1 µm crasso, sparsim valde subtiliter punctato-verruculoso; imago obliqua sporarum levis.

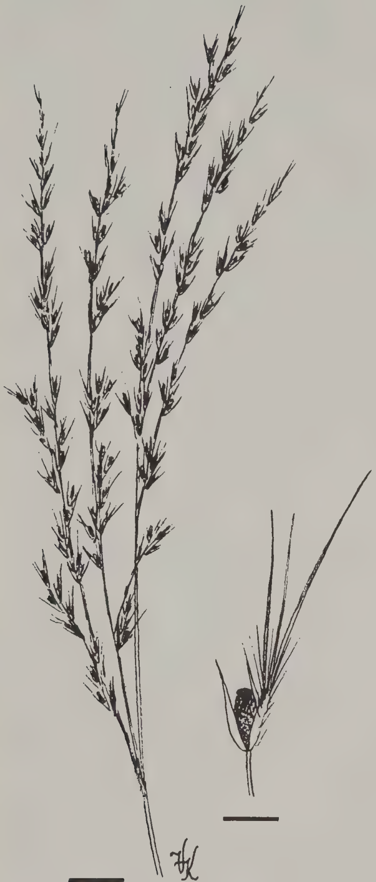
Sori (Fig. 9) in all ovaries of an inflorescence, often including also the inner floral organs, ovoid to long ellipsoidal, apiculate, 0.5–1 x 1.5–3 mm, lead coloured, covered by a thin, silvery membrane of host origin which ruptures irregularly disclosing the blackish-brown, powdery mass of spores. No columella in the sori, no sterile cells between the spores. *Spores* (Figs. 11, 12) variable in shape and size, subglobose, ellipsoidal, elongated, subpolyhedrally irregular, rarely apiculate, 6.5–9.5(–10.5) x 8–13(–14.5) µm, reddish-brown; wall evenly to slightly unevenly thick, 0.5–1 µm wide, very finely, sparsely punctate-verruculose; spore profile smooth.

On *Triraphis schinzii* Hackel; S. Africa (Zambia). Known only from the type collection.

The excellent Australian phanerogamist, collector and specialist of the flora of arid areas, Dr. P. K. Latz (Alice Springs), collected also several diseased grasses. Between these, there is an unknown smut fungus which is described as:

Ustilago latzii Vánky, sp. nov.

Typus in matrice *Triraphis mollis* R. Br., Australia, Northern Territory, 20 km SSW. Alice Springs, 23°50' S, 133°49' E, 6.IV.1976, leg. P. K. Latz 6466. Holotypus in DAR 28373, isotypi in CANB, NT et in HUV 17804!



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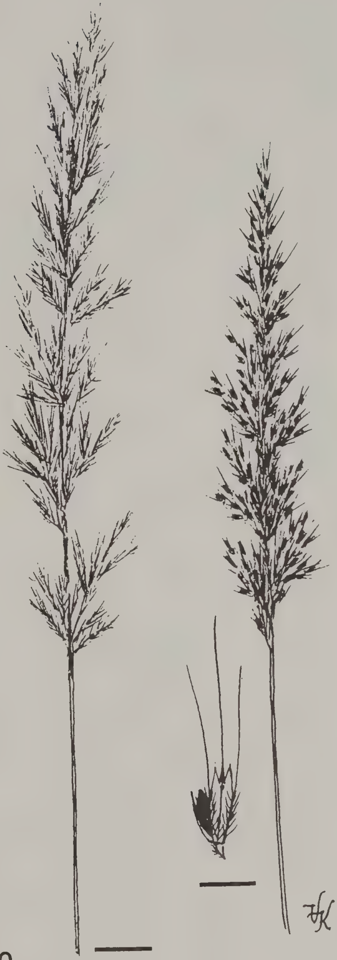

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Fig. 9. Sori of *Ustilago triraphidis* Vánky in all ovaries and also in flowers of some panicle branches of *Triraphis schinzii* Hackel (type). Enlarged a floret with a sorus.

Fig. 10. Sori of *Ustilago latzii* Vánky in the ovaries of *Triraphis mollis* R. Br. (type). Enlarged a floret with a sorus. To the left a healthy inflorescence.

Bars = 1 cm for the habit, 2 mm for the detail drawings.

Sori in ovariis, citriformes, cca. 1 x 1,5–2 mm, primo membrana tenui, cineracea, origine plantae nutrientis cooperti, qua irregulariter rupta massam sporarum atrobrunneam, pulveream ostendentes. *Sporae* subglobosae, plerumque ellipsoidales, 8–12 x 9–13 µm, flavidobrunneae; pariete aequali, cca. 0,5 µm crasso, mediocriter dense, leniter echinulato; imago obliqua sporarum leniter serrulata.

Sori (Fig. 10) in ovaries, lemon-shaped, c. 1 x 1.5–2 mm, initially covered by a thin, greyish membrane of host origin which ruptures irregularly disclosing the dark brown, powdery mass of spores. *Spores* (Figs. 13, 14) subglobose, usually ellipsoidal, 8–12 x 9–13 µm, yellowish-brown; wall even, c. 0.5 µm thick, moderately densely, finely echinulate; spore profile finely serrulate.

On Gramineae: *Triraphis mollis* R. Br.; Australia. Known only from the type collection.

Key to the smut fungi (*Ustilago*) of *Triraphis*

- Spores variable in shape and size, often irregular, reddish-brown; wall 0.5–1 µm thick, very finely punctate; spore profile smooth.......... *U. triraphidis*
- Spores regular, yellowish-brown, wall c. 0.5 µm thick, finely echinulate; spore profile finely serrulate .... *U. latzii*

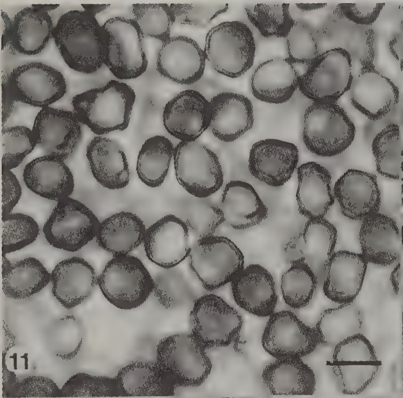
THE SMUT FUNGI OF CHIONACHNINAE (GRAMINEAE)

The "close-knit" subtribe Chionachninae Clayton belongs to the subfamily Panicoideae, tribe Andropogoneae. According to Clayton and Renvoize (1986:371) this subtribe comprises four genera, separated by relatively slight differences: **1**. *Chionachne* R. Br., with seven species in S. & S-E. Asia, Australia and Polynesia, **2**. *Polytoca* R. Br., with two species in S. & S-E. Asia, **3**. *Sclerachne* R. Br. with one species in S-E. Asia and Indonesia, and **4**. *Trilobachne* Henrard with one species in India. No smut fungus is known on *Sclerachne* or *Trilobachne*. To date, five smut fungi have been reported on species of *Chionachne* and *Polytoca*, but a further species is described in this paper, and two others in Vánky & Shivas (in press). The recognised eight species are:

Figs. 11, 12. Spores of *Ustilago triraphidis* Vánky on *Triraphis schinzii* Hackel, in LM and in SEM (type).

Figs. 13, 14. Spores of *Ustilago latzii* Vánky on *Triraphis mollis* R. Br., in LM and in SEM (type).

Figs. 15, 16. Spore ball remnant, spores and sterile cells of *Sporisorium polytocae-digitatae* Vánky on *Polytoca digitata* (L. fil.) Druce, in LM and in SEM (type). Bars = 10 µm.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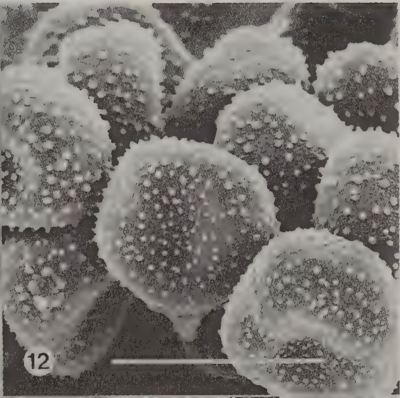
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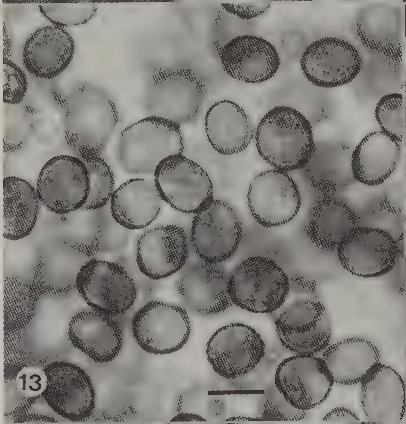
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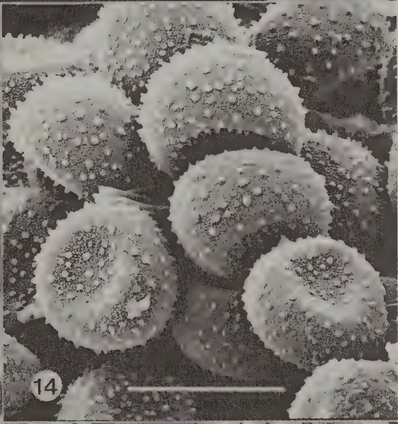
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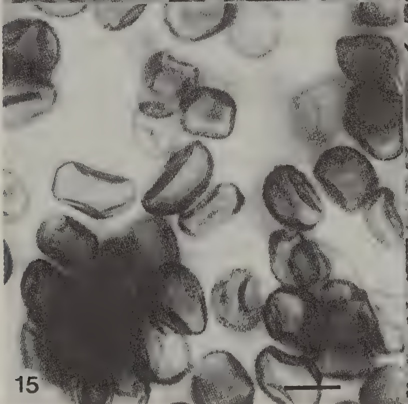
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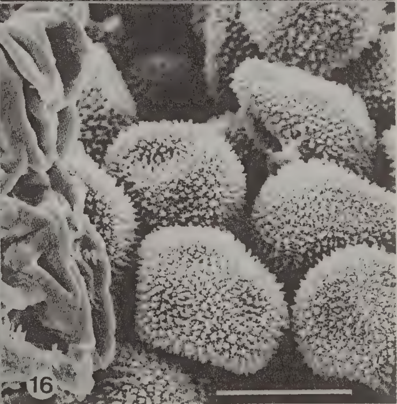

16

1. *Sporisorium polytocae* (Mundk.) Vánky, **comb. nov.**

Basionym: *Ustilago polytocae* Mundkur, Trans. Brit. Mycol. Soc. 23:118, 1939. – Type on *Polytoca barbata* (Roxb.) Stapf, India, Belgaum Distr., at Gosenhatti, 2.IX.1916, G. S. Kulkarni. Holotype in HCIO 7546, isotypes in HUV 17342! and in IMI 39405.

Sori destroying some spikelets of a raceme, initially enclosed by the hard lower glume ("fruit-case") and also covered by a brown, leathery peridium which ruptures from its apex disclosing the dark brown, pulverulent mass of spore balls, spores and groups of sterile cells. *Spore balls* subglobose, ellipsoidal, elongated or irregular, 40–70 x 50–100 µm, reddish-brown, composed of tens of easily separating spores. *Spores* mostly subpolyhedrally irregular, more rarely globose or broadly ellipsoidal, 10–13.5 x 11–15 µm, yellowish to reddish-brown; wall even, c. 1 µm thick, densely, finely punctate-echinulate; spore profile smooth to finely serrulate. *Sterile cells* 8–12 µm long, subhyaline to pale yellow, wall thin (c. 0.5 µm), agglutinated in irregular or elongated groups of different sizes.

On *Polytoca barbata* (Roxb.) Stapf (*Coix barbata* Roxb., *Chionachne barbata* (Roxb.) Benth., *Chionachne koenigii* (Spreng.) Thwaites & Hook. fil.), *P. wallichiana* (Nees) Benth. (n. v.); S. Asia (Burma, India), Australia.

2. *Sporisorium polytocae-barbatae* (Mundk.) Vánky, **comb. nov.**

Basionym: *Ustilago polytocae-barbatae* Mundkur, Trans. Brit. Mycol. Soc. 24:314, 1940. — Type on *Polytoca barbata* (Roxb.) Stapf, India, Maharashtra State, Amraoti Distr., Sipna Valley, 11.X.1908, I. H. Burkill, HCIO 7547!

Sori in the spikelets, usually congested, 5–10 mm long, initially covered by a peridium which ruptures disclosing the brown, powdery mass of loose spore balls, spores and sterile cells surrounding several, stout, short, simple columellae. *Spores* when mature single, globose, ovoid, rarely elongated or irregular, 5.5–9 x 6.5–11 µm, yellowish-brown; wall even, c. 0.8 µm thick, in LM sparsely, minutely verrucose; spore profile smooth, in SEM sparsely, finely echinulate, between the low spines finely verrucose. *Sterile cells* in irregular groups, single cells variable in shape and size, globose, ellipsoidal to irregular, with one or several flattened sides, subglobose cells 4–15 µm in diam., subhyaline; wall 0.5–1 µm thick, smooth.

On *Polytoca barbata* (Roxb.) Stapf, *P. macrophylla* Benth; S. Asia (India), Papua New Guinea.

Study of the type specimen revealed only the presence of a typical *Ustilaginoidea* (mitosporic fungus), with 5.5–7 µm long spores, provided with prominent warts. It differs markedly from the original description of *Ustilago polytocae-barbatae*, in which the sori are in the ovaries, held together by the floral envelopes, blackish-brown, not much inflated, sometimes with a columella, the spores are pulverulent, globose to subglobose, 6.3–10.9 µm in diameter, minutely, almost imperceptibly pitted, with smooth profile. Despite the statement in the description of this species, there is no type deposited in IMI (Dr. J. C. David, in litt.). A detailed description of this smut was possible from a specimen collected recently in Papua New Guinea, which agrees with the short original description.

3. *Sporisorium polytocae-digitatae* Vánky, sp. nov.

Typus in matrice *Polytoca digitata* (L. fil.) Druce (det. H. Scholz, B), Burma, Kywetnepha, 1.XI.1972, leg. Mya Thaung (as "*Ustilago* ? on grass"). Holotypus in IMI 171326! Isotypus in Herbario Ustil. Vánky, HUV 19019!

Sori spiculas omnes racemi eiusdem destruentes, cylindrici, 1–2 x 3–7 mm, glumis pro parte obtecti, primo peridio flavidobrunneo, coriaceo cooperti, quo irregulariter rupto massam atrobrunneam, agglutinatam usque pulveream glomerulorum sporarum laxarum, sporas, catervasque cellularum sterilium columellam bene evolutam, crassam, acutatam, usque ad 15 mm longam, ramis nonnullis, brevibus lateralibus, interdum etiam ramis paucis longioribus terminalibus praeditam circumdantium ostendentes. *Glomeruli sporarum* subglobosi, ellipsoidales, elongati vel parum irregulares, 20–40 x 30–60 µm, rufobrunnei, e sporis 10–50? facile separabilibus compositi. *Sporae* subglobosae, ovoideae, late ellipsoidales, usque parum irregulares, magnitudine variae, 9–12 x 9,5–16(–19) µm, rufobrunneae; pariete aequali, cca. 1 µm crasso, dense, conspicue echinulato; imago oblique sporarum serrata. *Cellulae steriles* in catervis compacis, subglobosis, elongatis vel irregularibus, 20–50 µm longis, subhyalinis, e cellulis paucis usque multis, subglobosis, ellipsoidalibus, plerumque irregularibus, latere uno vel lateribus nonnullis deplanatis compositis; cellulae singulae 6–16 µm longae, guttulis oleosos parvis nonnullis; pariete tenui, cca. 0,5 µm, levi.

Sori (Fig. 17) destroying all spikelets in a raceme, cylindrical, 1–2 x 3–7 mm, partly concealed by the glumes, initially covered by a yellowish-brown, leathery peridium which ruptures irregularly, disclosing the dark brown, agglutinated to powdery mass of loose spore balls, spores and groups of sterile cells surrounding a well-developed, stout, tapering columella, up to 15 mm long, with several, short, lateral branches, sometimes also with a few, longer, terminal branches. *Spore balls* subglobose, ellipsoidal, elongated or slightly irregular, 20–40 x 30–60 µm, reddish-brown, composed of 10–50? easily separating spores. *Spores* (Figs. 15, 16) subglobose, ovoid, broadly ellipsoidal to slightly irregular, variable in size, 9–12 x 9.5–16(–19) µm, reddish-brown; wall even, c. 1 µm thick, densely, evidently echinulate; spore profile serrate. *Sterile cells* (Fig. 16) in compact, subglobose, elongate or irregular groups, 20–50 µm long, subhyaline, composed of few to numerous, subglobose, ellipsoidal, usually irregular cells with one or several flattened sides, single cells 6–16 µm long, with a few, small oil droplets; wall thin, c. 0.5 µm, smooth.

On *Polytoca digitata* (L. fil.) Druce; S. Asia (Burma).

4. *Sporisorium reilianum* (Kühn) Langdon & Fullerton, 1978:452.

Type on *Sorghum vulgare* Pers., was reported by Walker & Shivas (1998:1203) on *Chionachne hubbardiana* Henrard from Australia. Further studies are needed to elucidate if the smut fungi on *Chionachne* (Chionachninae) and on *Sorghum* (Sorghinae) represent the same species.

5. *Sporisorium simile* R. G. Shivas & J. Walker, in Walker & Shivas, 1998:1207. Type on *Chionachne hubbardiana* Henrard, Australia, Western Australia, Kununurra, II.1984, J. Warren. Holotype in PERTH 793000. Topotype: Kununurra, 23.V.1984, R. G. Shivas & J. Warren, PERTH 790931, DAR 49437, IMI 287224, HUV 18967!

Sori destroying all racemes of an inflorescence, 1–2 cm long, initially covered by a creamy-white, thick peridium which later ruptures exposing the dark brown, powdery mass of spore balls, spores and sterile cells surrounding a repeatedly branched columella with tapering branches. *Spores* when mature single, globose, subglobose to broadly ellipsoidal, 6.5–9 x 8–10.5 µm, brown; wall even, c. 1 µm thick, prominently echinulate; spore profile serrulate. *Sterile cells* in smaller or larger, irregular groups, single cells 9–16 µm in diam. *Spore germination* results in phragmobasidia on which laterally and terminally ovoid to long cylindrical basidiospores are produced (Walker & Shivas, 1998:1206, Fig. 6).

On *Chionachne hubbardiana* Henrard; Australia.

6. *Tilletia chionachnes* Vánky, C. Vánky & R. G. Shivas,
in Vánky & Shivas (in press)

Type on *Chionachne cyathopoda* (F. Muell.) F. Muell. ex Benth., Australia, Queensland, Cape York Peninsula, 3 km N. oppid. Bamaga, 10°51'15" S, 142°24'09" E, alt. c. 50 m., 7.III.2000, leg. R. G. Shivas, P. Whittle, C. & K. Vánky. Holotype in BRIP 26898, isotypes in HUV 19174 and in Vánky, Ust. exs. no. 1083.

For description and illustration see Vánky & Shivas (in press).

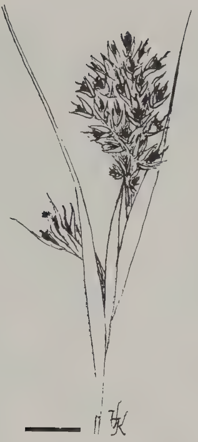
7. *Tilletia kimberleyensis* Vánky & R. G. Shivas (in press).

Type on *Chionachne cyathopoda* (F. Muell.) F. Muell. ex Benth., Australia, Western Australia, Kimberley Region, 5.5 km W. of Kununurra, junction of Ord and Dunham Rivers, 15°46'35" S, 128°41'12" E, 1.V.1999, leg. A. A. Mitchell 5779. Holotype in BRIP 25642, isotype in HUV 19173!

On *Chionachne cyathopoda* (F. Muell.) F. Muell. ex Benth.; Known only from the type collection in Australia.

For description and illustrations see Vánky & Shivas (in press).

Both *Tilletia chionachnes* and *T. kimberleyensis* differ from *T. punensis*, i.a., in having smaller spores and lower ornamentation. In *T. chionachnes* the spores are globose, subglobose to broadly ellipsoidal, 22–30 x 23–36 µm, yellowish- to dark chocolate-brown or opaque; wall 4.5–6 µm thick including the 2.5–4 µm high warts. *T. kimberleyensis* differs from *T. chionachnes* in shape, size, wall-thickness and colour of the spores. In *T. kimberleyensis* the spores are globose or subglobose, 16–24 x 16–24(–26) µm, yellowish- to dark brown, never opaque; wall 2.5–4.5 µm thick, including the 1.5–3.5 µm high warts.



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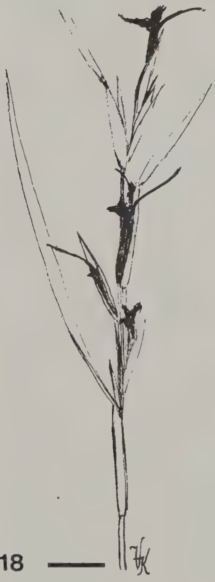

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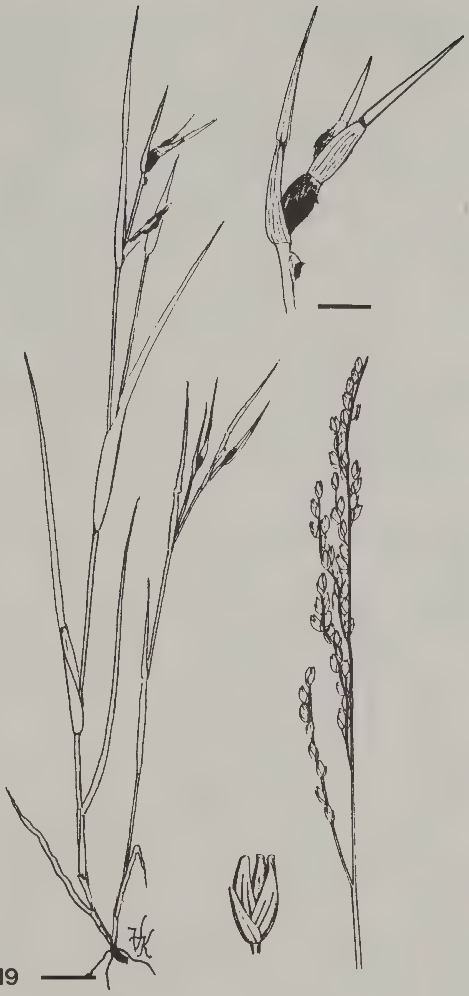


19

Fig. 17. Sori of *Sporisorium polytocae-digitatae* Vánky in the spikelets of *Polytoca digitata* (L. fil.) Druce (type).

Fig. 18. Sori of *Sporisorium coelorachidis* Vánky in the racemes of *Coelorachis clarkei* (Hackel) Blatter & McCann (type).

Fig. 19. Sori of *Ustilago acroceratis* Vánky on the distal part of the stems of *Acroceras macrum* Stapf (type). To the right a healthy inflorescence and a spikelet (reproduced from Gibbs Russel et al., 1991:32).

Bars = 1 cm for the habit, 2.5 mm for the detail drawing (top right).

8. *Tilletia punensis* (S. D. Patil & Gandhe) Vánky, comb. nov.

Basionym: *Neovossia punensis* S. D. Patil & Gandhe, Maharashtra Vidnyan Mandir Patrika 12:48, 1977. — Type on *Polytoca barbata* (Roxb.) Stapf, India, Poona, 10.XII.1975, R. V. Gandhe, D. B. Kapadnis & K. G. Date. Holotype in Herb. Dr. R. V. Gandhe (Poona, India), isotype in HUV 19029!

Sori in the ovaries, swollen, deformed, globose to ovoid, 4–5 mm in diam., covered by a thick, brown membrane which opens from its apex disclosing the black, powdery mass of spores and sterile cells. *Spores* globose, subglobose, rarely broadly ellipsoidal, 28–48 x 32–50 µm in diam., dark blackish-brown, opaque, covered by densely situated, 3–6.5 µm long, thin, obtuse warts. In young spores these are filiform. In nearly mature, smoky-brown spores the top of the warts, seen in surface view, appears irregularly polygonal. Spores sometimes provided with a short, hyaline appendage. In a sorus, spores of different maturity are present simultaneously. *Sterile cells* few, smaller than the spores, subhyaline, thick-walled, smooth. *Spore germination* results in a holobasidium bearing apically many acicular basidiospores which, without fusing, produce ballistospores (Patil & Gandhe, 1977:47, Figs. 13-16).

On *Polytoca barbata* (Roxb.) Stapf; S. Asia (India).

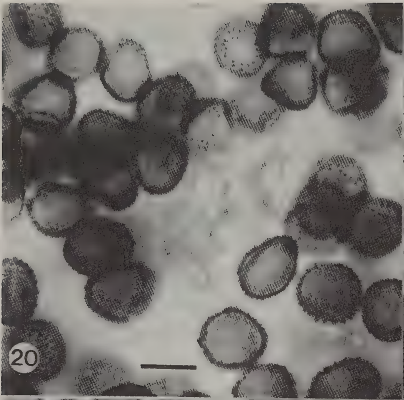
Key to the smut fungi of Chionachninae (*Chionachne*, *Polytoca*)

1. Spores more than 16 µm in diameter..........2
– Spores usually less than 16 µm in diameter..........4
2. Spores 32–50 µm long. On *Polytoca*.......... *Tilletia punensis*
– Spores smaller. On *Chionachne*..........3
3. Spores 23–36 µm long.......... *Tilletia chionachnes*
– Spores 16–24(–26) µm long.......... *Tilletia kimberleyensis*
4. Sori in the whole inflorescence. Columella much branched..........5
– Sori not in the whole inflorescence. Columella not much branched..........6
5. Spores 8–10.5 µm long, prominently echinulate.......... *Sporisorium simile*
– Spores 10.5–14.5 µm long, densely, minutely echinulate.......... *Spor. reilianum*
6. Spores 6.5–11 µm long, minutely verrucose.......... *Ustilago polytocae-barbatae*
– Spores 9.5–16 µm long, echinulate..........7
7. Spores mostly subpolyhedrally irregular, finely punctate-echinulate; spore profile smooth to finely serrulate.......... *Sporisorium polytocae*
– Spores mostly rounded, evidently echinulate; spore profile serrate.......... *Sporisorium polytocae-digitatae*

Figs. 20, 21. Spore balls, spores and sterile cells of *Sporisorium coelorachidis* Vánky on *Coelorachis clarkei* (Hackel) Blatter & McCann, in LM and in SEM (type).

Figs. 22, 23. Spores of *Ustilago acroceratis* Vánky on *Acroceras macrum* Stapf, in LM and in SEM (type).

Figs. 24, 25. Spores and sterile cells of *Tilletia cynodontis* Vánky on *Cynodon plectostachyus* (K. Schum.) Stapf, in LM and in SEM (type). Bars = 10 µm.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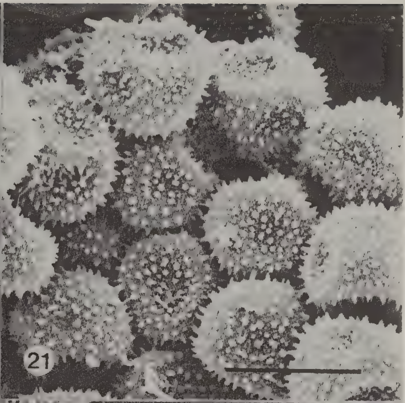
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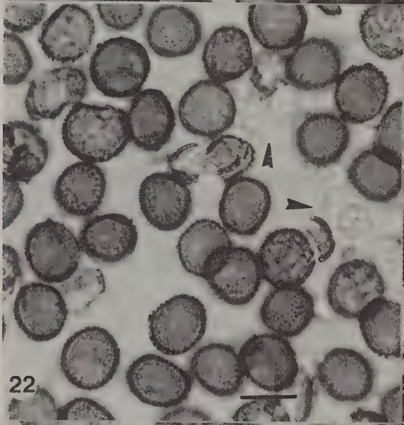
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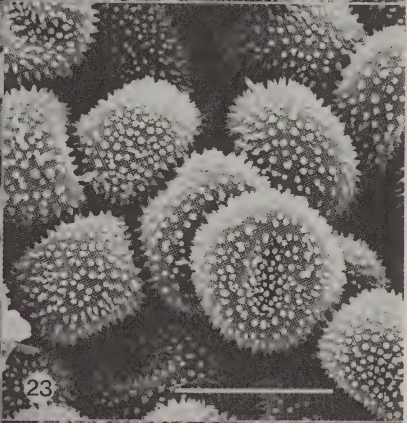
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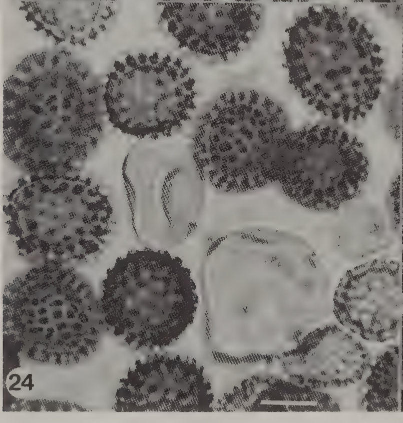
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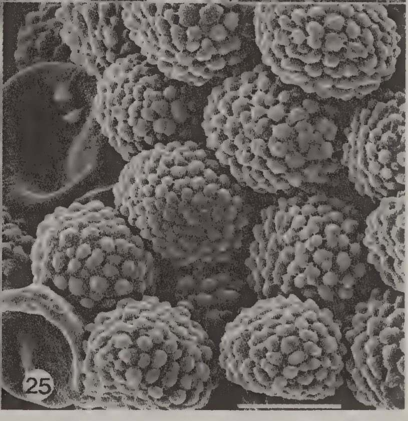
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A FURTHER SMUT FUNGUS OF *COELORACHIS* (GRAMINEAE)

I revised (Vánky, 2000:168-172) the smut fungi of *Coelorachis*, *Eremochloa*, *Hackelochloa*, *Lasiurus* and *Rhytachne*, of the subfamily Panicoideae, tribe Andropogoneae, subtribe Rottboelliinae. On these grass genera, six smut fungi have been recognised. A further, unidentified smut fungus in Herb. IMI on *Coelorachis clarkei* turned out to be a new species.

Sporisorium coelorachidis Vánky, **sp. nov.**

Typus in matrice *Coelorachis clarkei* (Hackel) Blatter & McCann, India, Bihar, Natarhat, 10.IX.1954, leg. J. N. Mishra (as *Sphacelotheca* sp.). Holotypus in IMI 60487!, isotypus in Herbario Ustil. Vánky, HUV 18969!

Sori racemos destruentes, racemi omnes eiusdem inflorescentiae affecti, cylindrici, 1–1,5 x 15–20 mm, primo peridio atrobrunneo, coriaceo cooperti, quo irregulariter rupto, massam sporarum atrobrunneam, pulveream cellularumque sterilium columellam bene evolutam, centralem, decrescentem, simplicem, raro cum ramulis brevibus praeditam cingentium ostendentes. *Sporae* maturae singulae, subglobosae, late ellipsoidales, ovoideae usque parum irregulares, 9,5–12 x 11–13,5 µm, rufobrunneae; pariete aequali, cca. 1 µm crasso (cum ornamento), satis dense, conspicue echinulato; imago obliqua serrulata. *Cellulae steriles* in catervis irregularibus, cellulae singulae globosae, ellipsoidales usque parum irregulares, 9–15 µm longae, specimina earum vetera collapsa, subhyalinae; pariete tenui (0,5–1 µm), levi.

Sori (Fig. 18) destroying the racemes, all racemes of the inflorescence are affected, cylindrical, 1–1.5 x 15–20 mm, initially covered by a dark brown, leathery peridium which ruptures irregularly disclosing the dark brown, powdery mass of spores and sterile cells surrounding a well-developed, simple, central, tapering columella, rarely with short branches. *Spores* (Figs. 20, 21) when mature single, subglobose, broadly ellipsoidal, ovoid to slightly irregular, 9.5–12 x 11–13.5 µm, reddish-brown; wall even, c. 1 µm thick (including ornamentation), rather densely, evidently echinulate; spore profile serrulate. *Sterile cells* (Figs. 20, 21) in irregular groups, single cells globose, ellipsoidal to slightly irregular, 9–15 µm long, collapsed in old specimens, subhyaline; wall thin (0.5–1 µm), smooth.

On *Coelorachis clarkei* (Hackel) Blatter & McCann (*Rottboellia clarkei* Hackel; *Manisuris clarkei* (Hackel) Bor); S. Asia (India). Known from the type collection only.

Sporisorium coelorachidis differs from *S. desertorum* (Thümen) Vánky (type on *Coelorachis hirsuta* (Forssk.) Brongn. = *Lasiurus hirsutus* (Forssk.) Boiss.) in sorus and spore characteristics. In *S. desertorum* there are several, long, filiform columellae in the sori, the spores are dimorphic (inner and outer spores in the balls are different), and sterile cells are absent. *S. coelorachidis* differs also from all known smut fungi on *Rottboellia* and related genera such as *Eremochloa*, *Hackelochloa*, *Lasiurus*, *Manisuris* and *Rhytachne*.

THE FIRST SMUT FUNGUS OF *ACROCERAS* (GRAMINEAE)

Acroceras Stapf, with 19 species in the Old World tropics, belongs to the subfam. Panicoideae, tribe Paniceae, subtribe Setariinae (Clayton & Renvoize, 1986:279). To date, no smut fungus has been described from *Acroceras*. In Herb. IMI there is a smutted sample which represents a new species:

Ustilago acroceratis Vánky, **sp. nov.**

Typus in matrice *Acroceras macrum* Stapf, Rhodesia, Salisbury [= Zimbabwe, Harare], 17.II.1932, leg. J. C. Hopkins (ut *Ustilago rabenhorstiana*). Holotypus in IMI 42546!, isotypus in HUV 19150!

Sori in parte distali caulium sicut tumores bullati, plerumque etiam partem basalem foliorum compressorum occupantes, 1–2,5 x 1–5 mm, primo epidermide, sicut membrana tenui, grisea cooperti, qua irregulariter rupta massam nigrobrunneam, semiagglutinatam usque pulveream sporarum cum cellulis parvis hyalinibus intermixtam ostendentes. Peridium fungale et columella absentes. *Sporae* globosae, subglobosae, ellipsoidales, raro parum irregulares, 9–11,5 x 9,5–13 µm, flavidobrunneae; pariete aequali, cca. 1 µm crasso (ornamento incluso), prominenter, dense, uniformiter echinulato, spinae cca. 0,5 µm altae, imago obliqua sporarum serrulata. *Cellulae hyalines* subglobosae, ovoideae, elongatae vel subpolyedriciter irregulares, 4–8 x 5–10 µm, solitariae vel in catervis satis laxis, minoribus vel majoribus, irregularibus dispositae; pariete tenui (cca. 0,5 µm), aequali, levi; contentus inclusione hyalina, globoidea (nucleus?) of 1–1,5 µm diametro praeditus.

Sori (Fig. 19) on the distal part of the stems as bullate swellings, usually comprising also the basal part of the congested leaves, 1–2.5 x 1–5 mm, initially covered by the epidermis as a thin, greyish membrane which ruptures irregularly disclosing the blackish-brown, semiagglutinated to powdery mass of spores intermixed with small hyaline cells. Fungal peridium and columella are lacking. *Spores* (Figs. 22, 23) globose, subglobose, ellipsoidal, rarely slightly irregular, 9–11.5 x 9.5–13 µm, yellowish-brown; wall even, c. 1 µm thick (including ornamentation), prominently, densely, uniformly echinulate, spines c. 0.5 µm high; spore profile serrulate. *Hyaline cells* (Fig. 22) subglobose, ovoid, elongate or subpolyhedrally irregular, 4–8 x 5–10 µm, solitary or in smaller or larger, rather loose, irregular groups; wall thin (c. 0.5 µm), even, smooth; content with a hyaline, globoid inclusion (nucleus?) of 1–1.5 µm diam.

On *Acroceras macrum* Stapf; S. Africa (Zimbabwe). Known only from the type collection.

The hyaline cells (with nuclei?) between the spores (Fig. 22, arrowheads), which resemble sterile cells, most probably are young spores. Sterile cells are not typical for *Ustilago*.

A NEW *TILLETIA* SPECIES (TILLETIALES)

Tilletia cynodontis Vánky, **sp. nov.**

Typus in matrice *Cynodon plectostachyus* (K. Schum.) Stapf (det. R. B. Stewart), Ethiopia, Alamata, XI.1955, leg. R. B. Stewart D-225. Holotypus in BPI 172310!

Sori in ovariis nonnullis inflorescentiae eiusdem, inconspicui, ovoidei, cca. 1 x 1,5 mm, involucris floralibus plus-minus obtecti, primo pericarpio tenui, brunneolo cooperti, quo irregulariter rupto massam nigram, pulveream sporarum cum cellulis sterilibus intermixtam ostendentes. *Sporae* ovoideae, ellipsoidales, rarius globosae vel parum irregulares, 13,5–20 x 16–25 µm, flavido- usque atro-rufobrunneae, verrucis asperis, 1–2(–2,5) µm altis, conicis, subconicis vel complanatis, visu superficiali quasi areis atris, irregulariter polygonalibus instructae. *Cellulae steriles* subglobosae, ovoideae, ellipsoidales usque irregulares, 9–28 x 12–36 µm, pallide flavidobrunneae, in specimenibus senecibus collapsae; pariete 1–2,5 µm crasso, levi.

Sori (Fig. 26) in some ovaries of an inflorescence, inconspicuous, ovoid, c. 1 x 1.5 mm, more or less hidden by the floral envelopes, initially covered by the thin, brownish pericarp which ruptures irregularly disclosing the black, powdery mass of spores intermixed with sterile cells. *Spores* (Figs. 24, 25) ovoid, ellipsoidal, more rarely globose or slightly irregular, 13.5–20 x 16–25 µm, yellowish- to dark reddish-brown, provided with coarse, 1–2(–2.5) µm high, conical, subconical or flattened warts, in surface view appearing as darker, irregularly polygonal areas. *Sterile cells* (Figs. 24, 25) subglobose, ovoid, ellipsoidal to irregular, 9–28 x 12–36 µm, pale yellowish-brown, collapsed in old specimen; wall 1–2.5 µm thick, smooth.

On *Cynodon plectostachyus* (K. Schum.) Stapf; E. Africa (Ethiopia). Known only from the type collection. This is the sole known *Tilletia* sp. on *Cynodon*.

26

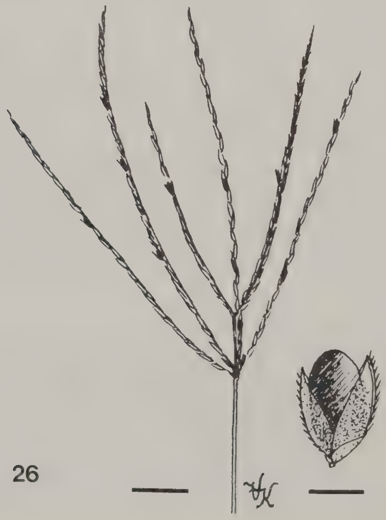

Fig. 26. Sori of *Tilletia cynodontis* Vánky in some of the ovaries of an inflorescence of *Cynodon plectostachyus* (K. Schum.) Stapf (type). Bars = 1 cm for the habit, 1 mm for the detail drawing.

THE SMUT FUNGI OF *PASPALIDIUM* (GRAMINEAE)

Paspalidium Stapf, with c. 40 species throughout the tropics, belongs to the subfamily Panicoideae, tribe Paniceae, subtribe Setariinae (Clayton and Renvoize, 1986:291). On *Paspalidium* five smut fungi could be recognised, including a new species. *Ustilago panici-geminati* Viégas turned out to be a synonym of *U. rickeri* G. P. Clinton.

1. "*Melanotaenium*" *brachiariae* var. *paspalidii* Srinivasan & Thirumalachar, 1963(1964):20.

Type on *Paspalidium geminatum* (Forssk.) Stapf, India, Maharashtra State, Poona, Pimpri, 9.X.1956 (n. v.).

Sori in the leaves, leaf-sheaths and flowering shoots forming 0.5–2 mm wide, 1–3 cm long, non erumpent, dull greyish-black streaks or patches. *Spores* closely packed, globose, subglobose, sometimes with a hyaline appendage, 8.5–14.5 x 8.8–15.5 µm, dark brown. *Spore germination* results in an unseptate basidium developing a terminal whorl of basidiospores.

On *Paspalidium geminatum* (Forssk.) Stapf; S. Asia (India).

Thirumalachar & Pavgi (1952:391) reported *Entyloma speciosum* J. Schröt. & Henn. (type on *Panicum* sp., Brazil) on *Paspalidium flavidum* (Retz.) A. Camus, from India, "showing characters of a *Melanotaenium*". It might represent *Melanotaenium brachiariae* var. *paspalidii*.

"*Melanotaenium*" and dark-spored "*Entyloma*" species on Gramineae (and Cyperaceae) belong to undescribed genera in the Georgefischeriales (see above under "*Melanotaenium*" *arthraxonis*).

2. *Sporisorium panici* (E. Mackinnon) Vánky, **comb. nov.**

Basionym: *Sorosporium panici* E. Mackinnon, J. & Proc. Roy. Soc. New South Wales 46:201, 1912. — Type on "(?) *Panicum flavidum* Retz." = *Paspalidium aversum* Vickery (rev. J. W. Vickery), Australia, New South Wales, Nyngan Experiment Farm, II.1911, E. Mackinnon. Holotype in DAR!, isotype in IMI 46368.

Sori in all spikelets of an inflorescence, more or less completely destroying the inner floral organs and the basal part of the inner floral envelopes which are swollen (looking like sori of *Ustilago bullata*), partly enclosed by the intact glumes. Sori 1–2 x 2–3 mm, including the acute tip, the remnants of the inner floral envelopes, covered by a thin, greyish peridium which ruptures irregularly disclosing the blackish-brown, powdery spore masses surrounding a stout, central columella with short lateral branches. Spore mass composed of large, loose, many-spored balls, which in mature sori disintegrate. *Spores* subpolyhedrally irregular or ellipsoidal, 8–10.5(–11.5) x 9.5–14(–16) µm, yellowish-brown; wall even, 0.5–0.8 µm thick, moderately densely, finely echinulate, in SEM, between the spines, densely, finely verrucose; spore profile in LM smooth to serrulate. *Sterile cells* not seen.

On *Paspalidium aversum* Vickery, *P. constrictum* (Domin) C. E. Hubb., *P. jubiflorum* (Trin.) Hughes, *Panicum maximum* Jacq.; Australia, S. Africa.

The smut fungus on *Panicum maximum* Jacq. from South Africa is indistinguishable from *Sporisorium panici* on *Paspalidium*, except for the thicker peridium which is yellowish-brown in infected *Panicum maximum*, and the sori are more often destroying the inner floral envelopes completely, not only their basal part.

3. ***Ustilago panici-gracilis*** E. Mackinnon, 1912:202.

Type on *Panicum gracile* R. Br. (= *Paspalidium gracile* (R. Br.) Hughes), Australia, New South Wales, Nyngan Experiment Farm, II.1911, E. Mackinnon. Holotype in DAR 2206, isotypes in HUV 17608!, IMI 46367

Ustilago clelandii H. Sydow, 1937:24. — Type on *Paspalidium gracile* (R. Br.) Hughes, Australia, South Australia, Encounter Bay, 28.I.1936, J. B. Cleland. Holotype probably lost in Berlin (B). Isotypes in HUV 15438! and in KEW.

Sori destroying the whole inflorescence including the distal part of the shoot with shortened internodes, comprising also the basal, swollen part of the distal leaves. Sori elongated, cylindrical and irregularly bullate with still not destroyed distal part of the leaves, 1.5–4 x 3–15 mm, initially covered by the epidermis which ruptures irregularly disclosing the dark brown, semiagglutinated to powdery mass of spores surrounding the floral stem or axis as a thick columella with short lateral branches. More rarely sori restricted to the inflorescence branches or to the spikelets only, or subepidermal, bullate, then smaller, 1.5–3(–5) mm long. *Spores* ovoid, ellipsoidal, elongated to slightly irregular, more rarely subglobose, 9–12 x 9.5–13.5(–16) µm, yellowish-brown; wall even, 0.8–1 µm thick, densely, finely echinulate; spore profile serrulate; in SEM between the spines finely verrucose.

On *Paspalidium constrictum* (Domin) C. E. Hubb., *P. criniforme* S. T. Blake, *P. gracile* (R. Br.) Hughes (*Panicum gracile* R. Br.), and its var. *rugosum* Hughes; Australia.

4. ***Ustilago rickeri*** G. P. Clinton, 1906:11 (as "*rickerii*").

Type on *Panicum paspalodes* Pers. (= *Paspalidium geminatum* (Forssk.) Stapf), Cuba, Batabano, 13-20.III.1906, leg. A. S. Hitchcock, comm. P. L. Ricker. Holotype in BPI 166090!, isotype in BPI 166091!

Ustilago panici-geminati Viégas, 1944:745. — Type on *Panicum geminatum* Forssk. (= *Paspalidium geminatum* (Forssk.) Stapf), Brazil, Prov. Paríba, Alagoínha, Exp. Sta. Alagoínha, III.1940, J. Deslandes 6881. Holotype in IACM, isotype in HCIO 11660!

Ustilago paspalidicola Zambettakis, 1977:416. Invalidly published, no type indicated (ICBN 37.1). — On *Paspalidium geminatum* Stapf, Senegal, Dakar, 25.IV.1971, leg. Miege (Not found in PC; identified with help of the description and the beautiful illustration of the sori).

Sori in some of the spikelets of an inflorescence, often in groups, first partly protected by the glumes later much protruding, globose to ovoid, bearing remnants of anthers and tips of inner floral envelopes on their distal part. Sori 2–4(–5) x 3–4(–6) mm, covered by a smooth, initially green later grey membrane of plant tissue which ruptures irregularly disclosing the dark brown, semiagglutinated to powdery mass of spores. No sterile cells, no columella. *Spores* ovoid, broadly- to long ellipsoidal, more rarely globose or somewhat irregular, 5.5–8(–9) x 6.5–9(–10) µm, yellowish-brown; wall evenly 0.5–0.8 µm thick, sparsely, finely verrucose-echinulate which does not affect the spore profile; in SEM, between the sparse, low spines a few, small verrucae can be seen.

On *Paspalidium geminatum* (Forssk.) Stapf (*Panicum geminatum* Forssk.; *Panicum paspalodes* Pers.); Antilles (Cuba), S. America (Brazil), C. Africa (Senegal), S. Asia (India).

5. *Sporisorium horsfallii* Vánky, sp. nov.

Typus in matrice *Paspalidium rarum* (R. Br.) Hughes (det. D. Albrecht), Australia, Northern Territory, Davenport Range National Park, Camping area, 20°29'20" S, 134°31'04" E, 25.III.2000, leg. P. Horsfall 708, Herbario Ustil. Vánky, HUV 19205!

Sori sive in floribus omnibus eiusdem inflorescentiae, involucra floralis maxime externa intacte relinquentes, longe cylindrici vel fusiformes, 1–1,5 x 5–10 mm, sive inflorescentiam totam destruentes, praeterea majores (cca. 2 x 35–45 mm), primo peridio flavidobrunneo obtecti, quo irregulariter rupto massam glomerulorum sporarum atrobrunneam, granulosam-pulveream et columellam simplicem, flagelliformem, longitudine sori aequalem ostendentes. *Glomeruli sporarum* globoidei, ellipsoidales, elongati vel irregulares, magnitudine varii, 40–80 x 50–130 µm, rubrobrunnei, e multitudine sporarum leviter separabilium compositi. *Sporae* globosae, subglobosae, plerumque late ellipsoidales usque parum subpolyedrice irregularès, 6,5–9,5 x 8–10 µm, flavidobrunneae; pariete aequaliter crasso (cca. 0,5 µm), lenissime punctato usque verrucoso; imago obliqua sporarum levis usque lenissime undulata. *Cellulae steriles* non observatae.

Sori (Fig. 27) either in all flowers of an inflorescence, leaving intact the outermost floral envelopes, long cylindrical or fusiform, 1–1.5 x 5–10 mm, or destroying the whole inflorescence, then larger (c. 2 x 35–45 mm), initially covered by a yellowish-brown peridium which ruptures irregularly disclosing the dark brown, granular-powdery mass of spore balls and a simple, flagelliform columella of the length of the sorus. *Spore balls* (Figs. 29, 30) globoid, ellipsoidal, elongated or irregular, variable in size, 40–80 x 50–130 µm, reddish-brown, composed of many, easily separating spores. *Spores* (Figs. 29, 30) globose, subglobose, usually broadly ellipsoidal to slightly subpolyhedrally irregular, 6.5–9.5 x 8–10 µm, yellowish-brown; wall evenly thick (c. 0.5 µm), very finely punctate to verrucose; spore profile smooth to very finely wavy. *Sterile cells* not seen.

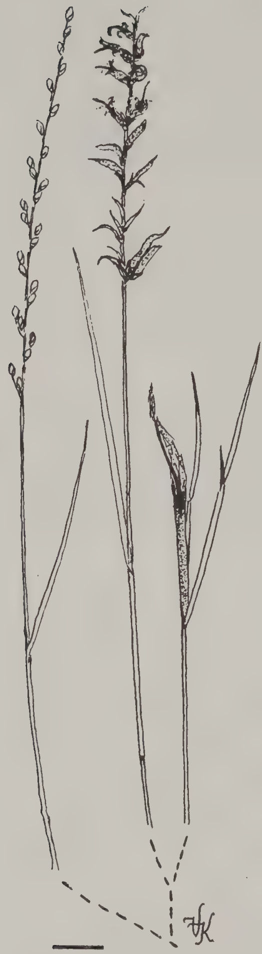

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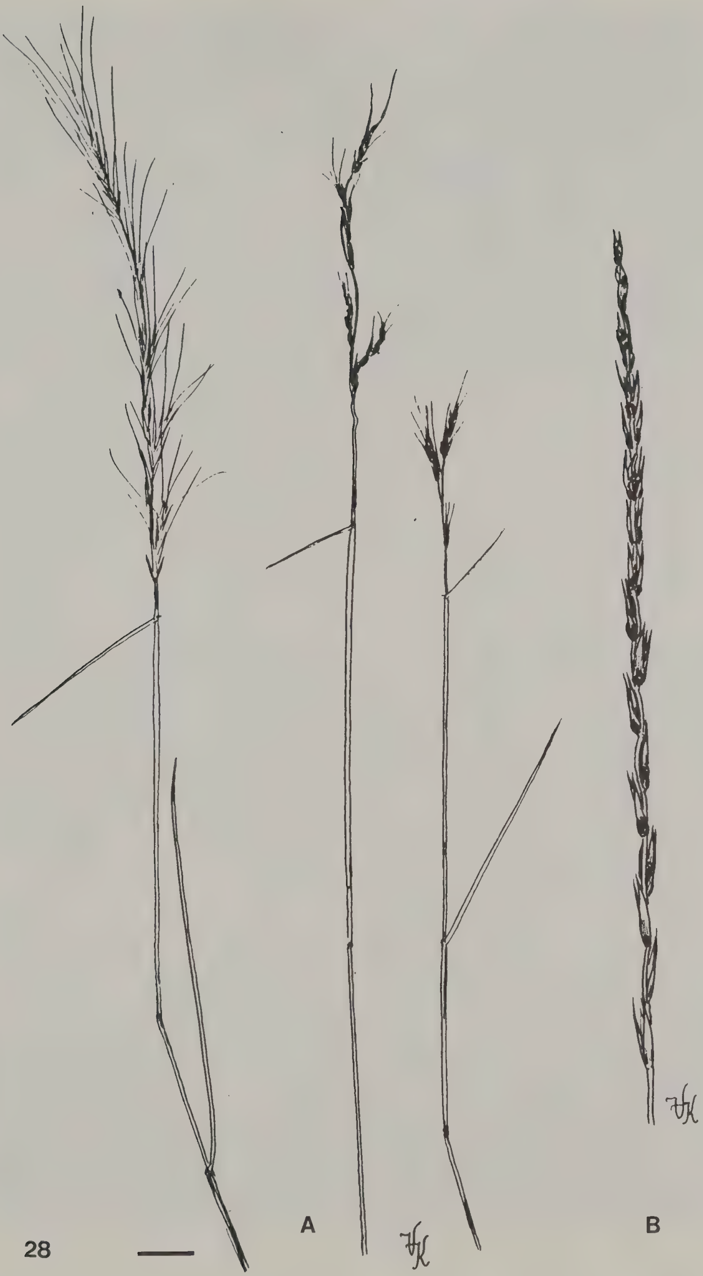
Fig. 27. Sori of *Sporisorium horsfallii* Vánky in the flowers (middle) or in the whole inflorescence (to the right) of *Paspalidium rarum* (R. Br.) Hughes (type). To the left, a shoot of the diseased plant which escaped infection and produced a healthy inflorescence. Bar = 1 cm.

Fig. 28. A. Sori of *Ustilago bullata* Berk., s. str. on *Elymus scaber* (R. Br.) Á. Löve. Two infected plants and, to the left, a healthy plant (Vánky, Ust. exs. no. 1044). B. Sori of *U. bromivora* (L.-R. & C. Tul.) A. A. Fischer Waldh. on *Agropyron tenerum* Vasey (Herb. mycol. rom. no. 1557). Bar = 1 cm.



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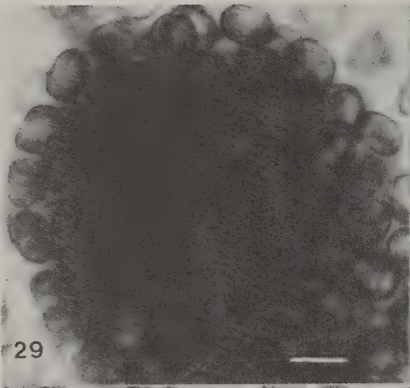
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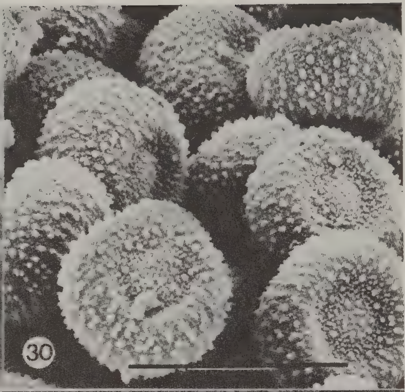
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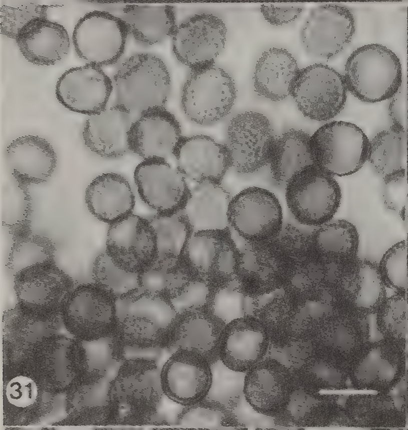
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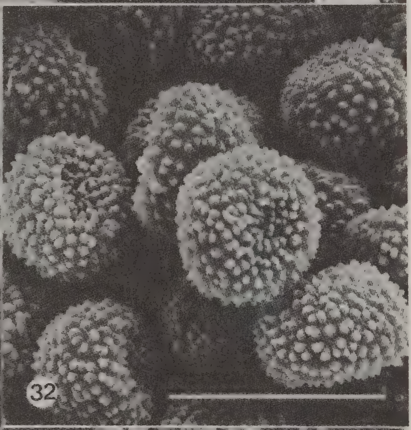
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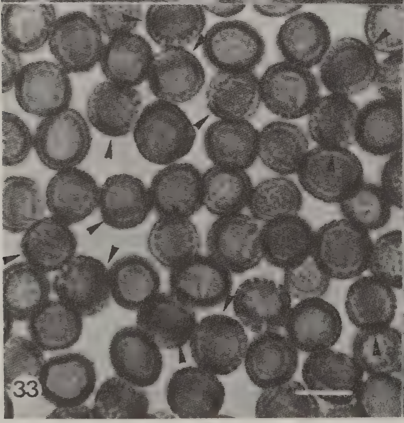
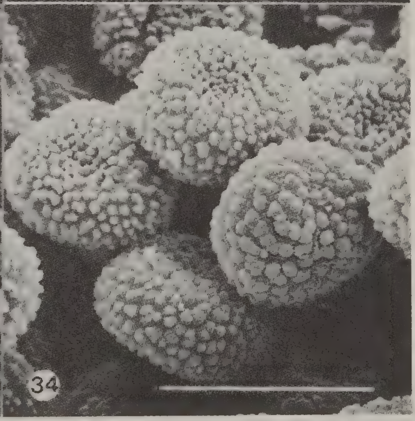

33


34

Key to the smut fungi of *Paspalidium*

1. Sori in the leaves and stems as lead-coloured, non erumpent spots.
Spores firmly agglutinated ...."*Melanotaenium*" *brachiariae* var. *paspalidii*
– Sori not so. Mature spores powdery..2
2. Spores 6.5–9(–10) µm long. Sori in some of the spikelets
of an inflorescence, 3–4(–6) mm long....................................*Ustilago rickeri*
– Spores larger. Sori in all spikelets or in the whole inflorescence.....................3
3. Spores 8–10 µm long, verrucose.................................*Sporisorium horsfallii*
– Spores 9.5–14(–16) µm long, finely echinulate..4
4. Sori usually in the whole inflorescence and distal part of the stem,
3–15 mm long..*Ustilago panici-gracilis*
– Sori in all spikelets of an inflorescence, 2–3 mm long ....*Sporisorium panici*

USTILAGO BULLATA AND *U. BROMIVORA* ARE DIFFERENT SPECIES

Study of smut fungi of New Zealand revealed on one hand that *Ustilago bullata* Berk. s. lat. comprises at least two, morphologically well delimited species, on the other hand that *U. asprellae* G. Cunn. is identical with *U. bullata* s. str.

At least 14 smut fungi have been described with more or less similar spores and sorus characteristics, often only on the basis of host specificity. With no critical study of this group of fungi by modern methods, they were often treated in a broad sense under the oldest name, *Ustilago bullata* Berk. s. lat. (e.g. Lindeberg, 1959; Vánky, 1985, 1994, Zogg, 1985(1986)). Study of *U. bullata* on the type host, *Elymus scaber*, and on different *Bromus* species, revealed significant differences in sorus and spore morphology, leading to the recognition of two species. For the smut fungi on *Bromus* (and other host genera, including also some species of *Elymus*) the second oldest name *Ustilago bromivora* (L.-R. & C. Tul.) A. A. Fischer Waldh. is available. In *U. bullata* s. str., the sori (Fig. 28 A) usually comprise the whole spikelet, often also the whole spike, leaving intact only the tip of some floral envelopes and their awns; the sori sometimes extend to the distal leaves as shorter or longer striae. In *U. bromivora*

Figs. 29, 30. Spore balls and spores of *Sporisorium horsfallii* Vánky on *Paspalidium rarum* (R. Br.) Hughes, in LM and in SEM (type).

Figs. 31, 32. Spores of *Ustilago bullata* Berk. on *Elymus scaber* (R. Br.) Á. Löve, in LM and in SEM (New Zealand, HUV 7557 ex PDD 22630). Note the acute ornamentation on the SEM picture.

Figs. 33, 34. Spores of *Ustilago bromivora* (L.-R. & C. Tul.) A. A. Fischer Waldh. on *Agropyron tenerum* Vasey, in LM and in SEM (Romania, Herb. myc. rom. no. 1557, HUV 3409). Note the darker, equatorial band of the spores on the LM picture (arrowheads), and the rounded warts on the SEM picture. Bars = 10 µm.

the destruction is less (Fig. 28 B), the sori being restricted to the basal part of the floral envelopes and to the ovaries. In *U. bullata* s. str., the spores (Figs. 31, 32) are uniformly pigmented, and seen in SEM they are verrucose-echinulate. In *U. bromivora* the spores (Figs. 33, 34), seen in LM, have a darker equatorial band (arrowheads), and seen in SEM they are verrucose, the warts have a rounded tip.

Ustilago bullata Berk., s. str., in Hooker, 1855:196. — Lectotype (designated by Lindeberg, 1959: 112) on *Triticum scabrum* R. Br. (= *Elymus scaber* (R. Br.) Á. Löve), New Zealand, North Island, 1849, coll. W. Colenso, K.

Ustilago asprellae G. Cunningham, 1930:414. — Type on "*Asprella gracilis* (Hook. f.) Kirk" (most probably misnamed *Elymus scaber* (R. Br.) Á. Löve, teste K. Vánky), New Zealand, South Island, Nelson, Korere, alt. c. 500 m, II.1929, H. H. Allan, PDD 3472!

On *Elymus rectisetus* (Nees) Löve & Connor, *E. scaber* (R. Br.) Á. Löve (*Triticum scabrum* R. Br., *Agropyron scabrum* (R. Br.) P. Beauv.); Australasia (Australia, New Zealand).

Ustilago bromivora (L.-R. & C. Tul.) A. A. Fischer von Waldheim, 1867:252. — Based on *Ustilago carbo* (DC.) L.-R. & C. Tul. α *vulgaris* L.-R. & C. Tul. d. *bromivora* L.-R. & C. Tulasne, 1847:81. – Lectotype (designated by Lindeberg, 1959:112) on *Bromus secalinus* L., Austria, Tirol, Hoedic, coll. F. Unger.

For synonyms, detailed description, European host plant range and illustrations see Vánky, 1994:352-353 & 394.

On *Agropyron, Brachypodium, Bromus* (incl. *Zerna*), *Elymus* (incl. *Clinelymus*), *Festuca, Hordeum, Lolium, Sitanion* spp.; world-wide.

THE SMUT FUNGI OF ARISTIDEAE (GRAMINEAE)

The tribe Aristideae of the subfamily Arundinoideae comprises three genera: *Sartidia* De Winter, with 4 species in Southern Africa and Madagascar, *Stipagrostis* Nees, with c. 50 species in Africa, Middle East, Central Asia and Pakistan, and *Aristida* L., a large homogenous genus with c. 250 species in the tropics and subtropics (Clayton & Renvoize, 1986:186). No smut fungus has been reported on *Sartidia*. On *Stipagrostis* one smut fungus is known, *Sphacelotheca aristidae-lanuginosae* Maire, which is a *Sporisorium*. On *Aristida* 20 smut fungi have been published. Of these several are synonyms. ***Sorosporium aristidae-amplissimae*** Beeli (1922:7) was excluded from the smut fungi (Vánky, 1997c:161), being a *Ustilaginoidea* sp. (mitosporic fungus). ***Sporisorium saharianum*** (Trotter) Karatygin was described on *Aristida pungens*. The host plant is actually *Sporobolus pungens* (Schreb.) Kunth.

The smut fungi of *Aristida* are a taxonomically difficult group. With the exception of a few, well-delimited species, most of these fungi belong to the complex species of *Sporisorium consanguineum* (Ellis & Everh.) Vánky, or to morphologically more or less close species. Intermediate forms are no exception. The identification of these smuts is also difficult because there is no strict host specificity; the same fungus may occur on different *Aristida* species, and the same *Aristida* species may be the host of several, closely related smut fungi. Because of the observed variations regarding shape and size of the spore balls and spores, spore wall thickness and ornamentation, dimorphism of the spores within the balls, persistence of the spore balls, etc., a clear delimitation of smaller taxa within *S. consanguineum* is difficult. However, the following forms may deserve species rank: *Sporisorium aristidicola* (Speg.) Vánky, *S. confusum* (H. S. Jackson) Vánky, *S. fraserianum* (H. Sydow) Vánky, and *S. goniosporum* (Massee) Vánky. A variation of ± 1–2 µm of the spore measurements within the same species is not unusual and is accepted.

In addition to earlier established synonyms, it turned out that both *Sorosporium consanguineum* Ellis & Everh. var. *bullatum* Pavgi & Thirum., and *Sorosporium penuriasorus* Durán are synonyms of *Sporisorium aristidicola* (Speg.) Vánky. *Sorosporium maroccanum* Unamuno, type on misnamed *Brachypodium*, is *Ustilago bromivora. Ustilago aristidicola* Henn. was found to be *Sporisorium microsporum* on misnamed *Paspalum*. Some species belong to another genus than the one in which they were published originally and are recombined. There are also a new *Sporisorium* species (to be published later) and a new *Tilletia* species. The recognised smut fungi and their synonyms are:

1. *Macalpinomyces aristidae-cyananthae* (Bref.) Vánky, **comb. nov.**
Basionym: *Ustilago aristidae-cyananthae* Brefeld, Untersuchungen aus dem Gesammtgebiete der Mykologie XII, Brandpilze III, p. 102, 1895. — *Sphacelotheca aristidae-cyananthae* (Bref.) Pavgi & Mundkur, 1949:111. — *Sorosporium aristidae-cyananthae* (Bref.) Zundel, 1953:53. — Type on *Aristida cyanantha* (Nees) Steudel, India, Uttar Pradesh, Dehra Dun, without date, comm. D. D. Cunningham (lost in Berlin, during the Second World War). Neotype (designated here) on *Aristida cyanantha*, India, Uttar Pradesh, Dehra Dun, Sewalik Hills, 27.XII.1908, R. S. Hole, HCIO 456! Isoneotypes in Herb. crypt. Ind. Orient. exs. II. Indian Ust. no. 14, HUV 5762!

Sori in the ovaries, transforming them into long, fusiform, olive-brown bodies, 1–2.5 x 5–25 mm, covered by a delicate peridium, formed by the pericarp and sporogenous hyphae. At maturity, the peridium ruptures longitudinally disclosing the agglutinated to granular powdery, deep chocolate-brown spore masses intermixed with a few sterile cells. No columella. On the inner surface of the peridium of young sori groups of "pseudo spore balls" can be seen. These are irregular, variable in shape and size, 30–130 µm long, opaque, are not surrounded by sporogenous hyphae, are composed of many, tightly packed spores which separate by pressure. *Spores* subpolyhedrally irregular, 4.5–6.5(–8) x 5–8(–9.5) µm, yellowish-brown; wall even, c. 0.5 µm thick, densely verrucose; spore profile wavy to finely serrulate. *Spore germination* (Brefeld, 1895:102, Pl. VI, figs. 1–4) results in 3-celled basidia which separate from the germinating spore. On the basidia, lateral and terminal, oblong-ovoid basidiospores are produced, which bud giving rise to yeast colonies. *Sterile cells* globose to broadly ellipsoidal, 5–7.5 x 5–8 µm, hyaline, single or in short rows; wall relatively thick (c. 1 µm), even, smooth.

On *Aristida cyanantha* (Nees) Steudel; S. Asia (India).

Pavgi & Mundkur (1949:111) compared the holotype of *Ustilago aristidae-cyananthae* from Berlin (B) with the topotype (= neotype) of this species and found them "to agree very well". Presence of "a delicate central columella", mentioned by Pavgi & Mundkur (1949:111), could not be confirmed.

2. ***Sporisorium aristidae*** (S. Ahmad) Vánky, **comb. nov.**

Basionym: *Tolyposporium aristidae* S. Ahmad, Mycol. Pap. 64:12, 1956. — *Sorosporium aristidae* (S. Ahmad) Thirumalachar & Neergaard, 1977(1978):183 (later homonym, not (Peck) Neger, 1896:789). — Type on *Aristida cyanantha* (Nees) Steudel, Pakistan, Murree, VIII.1952, S. Ahmad 4837, IMI 57432, HUV 18130!

Sori culmicolous, covered by the leaf sheaths, or in the spikelets, spore mass dark brown, pulverulent. *Spore balls* variable in shape and size, subglobose, ovoid, ellipsoidal, elongated or irregular, (30–)40–90(–110) x 50–120(–140) µm, dark reddish-brown to subopaque, rather permanent, composed of tens of spores. *Spores* globose, subglobose, ellipsoidal, somewhat irregular, or subpolyhedrally irregular, 8–12 x 9.5–13(–15) µm; outer spores reddish-brown, rounded, wall slightly unevenly thick, 1–1.5 µm, including the coarse verrucae or spines on the free surface of the spores; inner spores subpolyhedral, light yellowish-brown, wall thin (c. 0.5 µm), even, apparently smooth. *Sterile cells* not seen.

On *Aristida cyanantha* (Nees) Steudel; S. Asia (Pakistan).

According to the original description, the sori are culmicolous. However, a fragment of the type specimen in HUV represents a sorus in a spikelet, with a filiform columella. In species of *Sporisorium* it is not unusual that the sori are comprising the whole inflorescence or only the spikelets or both, even on the same infected plant.

3. ***Sporisorium aristidae-lanuginosae*** (Maire) Vánky, **comb. nov.**

Basionym: *Sphacelotheca aristidae-lanuginosae* Maire, Bull. Soc. Bot. France 53:CXCIX, 1906. — Type on *Aristida lanuginosa* Bosc (= *A. lanosa* Muhl. ex Ell.), Algeria, Beni-Ounif, 13.IV.1906, M. R. Maire.

Sori comprise the whole inflorescence destroying all of them in a plant, ovoid with acute tip, c. 0.5 x 1 cm, partly hidden by leaf sheaths, initially covered by a whitish to pale brown peridium which ruptures disclosing the blackish brown, semiagglutinated to powdery mass of spore balls and spores surrounding numerous, stout, 0.5–1 cm long columellae. *Spore balls* subglobose, ellipsoidal, elongated to irregular, 25–70 x 30–80 µm, dark reddish-brown, composed of tens of easily separating spores. *Spores* subglobose, ellipsoidal, elongate, usually subpolyhedrally irregular, 8–12 x 9.5–13.5(–15) µm, yellowish-brown; wall evenly thick, c. 1 µm, finely, densely verruculose; spore profile smooth to very finely serrulate. *Sterile cells* not seen.

On *Aristida lanosa* Muhl. ex Ell. (*A. lanuginosa* Bosc), *A. stricta* Michaux, *Stipagrostis karelini* (Trin. & Rupr.) Tzvel. (*Aristida karelini* (Trin. & Rupr.) Rozhev, *S. plumosa* (L.) Munro ex T. Anderson (*Aristida plumosa* L.), *S. rigidifolia* H. Scholz; Africa (Algeria, Libya, Tschad), Asia (Iran, Turkmeniya).

4. *Sporisorium aristidicola* (Speg.) Vánky, **comb. nov.**

Basionym: *Urocystis aristidicola* Spegazzini, Anales Mus. Nac. Buenos Aires, Ser. 3, 12:294, 1909. — *Tuburcinia aristidicola* (Speg.) Liro, 1922:26. — Lectotype (designated here) on *Aristida* "*complanata* Trin." (misnamed *A. macrophylla* Hackel, teste M. A. Torres), Argentina, Prov. Misiones, near Posadas, I.1907, C. Spegazzini, LPS 3681!, isolectotype BPI 181763!

Sorosporium consanguineum Ellis & Everh. var. *bullatum* Pavgi & Thirumalachar, 1951:10. — *Sorosporium bullatum* (Pavgi & Thirum.) Pavgi & Thirum., in Thirumalachar & Pavgi, 1956:284 (later homonym, not J. Schröter, 1869). — Type on *Aristida adscensionis* L., India, Uttar Pradesh, Varanasi, Benares Hindu University, 2.XI.1948, M. S. Pavgi, HCIO 20048!

Sorosporium penuriasorus Durán, 1987:67. — Type on *Aristida ternipes* Cav., Mexico, 1 mi W. of Hwy 15 on the road to San Blas, Nay, 28.X.1969, R. Durán, WSP 67741, isotype in HUV 14405!

Sori in some ovaries of a panicle, fusiform, swollen or obovoid with acute tip, 1–2 x 4–6 mm, covered by a thick, persistent peridium of pericarp and fungal cells. At maturity, the peridium ruptures irregularly along its side disclosing the semiagglutinated to granular powdery, black mass of spore balls intermixed with groups of sterile cells. *Spore balls* rather permanent, globose, subglobose, broadly ellipsoidal or slightly irregular, variable in size, (30–)40–90(–110) x (30–)40–120(–140) µm, reddish- or chestnut-brown to opaque. Young spore balls are surrounded by hyaline, partly gelatinised hyphae. *Spores* dimorphic, 6–9 x 6–10.5 µm, light reddish- to chestnut brown; inner spores polyhedral, thin-walled (c. 0.3–0.5 µm), smooth; outer spores slightly larger and darker than the inner ones, rounded, free wall subpolyhedral, 1–2 µm thick, including the 0.5–1.5 µm high, sparsely to moderately densely situated, coarse warts. *Sterile cells* in smaller or larger, irregular groups, single cells variable in shape and size, with one or several flattened sides, 3–7(–9) x 3–9(–12) µm, yellow or pale smoky brown; wall even, thin (0.3–0.5 µm), smooth.

On *Aristida adscensionis* L., *A. hystrix* L. fil., *A. ingrata* Domin, *A. macrophylla* Hackel, *A. mutabilis* Trin. & Rupr., *A. redacta* Stapf, *A. ternipes* Cav., and *A.* sp.; N. and S. America (Mexico, Argentina), Africa (Nigeria, Sudan), Asia (India), Australia.

Describing *Urocystis aristidicola*, Spegazzini (1909:294) mentioned two syntypes: 1. on *Aristida pallescens* Dur., Argentina, Prov. Cordoba, Juárez Celman, 5.I.1905, C. Spegazzini (LPS 3682!) and 2. on *Aristida complanata* Trin., Argentina, Prov. Misiones, near Posadas, I.1907, C. Spegazzini

(LPS 3681!). The first one is *Sporisorium consanguineum*, as already stated by Zundel (1953:310). The second one, the designated lectotype, to which Spegazzini's description refers, represents a different species which, according to Spegazzini (1909:294) "An ab *U. aristidae* Peck satis distincta" (*U. aristidae* = *S. consanguineum*). There is a third collection (LPS 3683!), with Spegazzini's handwriting "*Urocystis aristidicola* Speg. (n. sp.)" on *Aristida* sp. which also represents the new species. However, this is not mentioned in the protologue of *Urocystis aristidicola*.

Sporisorium aristidicola differs from *S. consanguineum* in having a thick, persistent peridium around the sori, in the rather permanent spore balls composed of slightly dimorphic spores (i.e. outer and inner spores in the balls are different in shape, size, colour and ornamentation), in the relatively coarse warts on the free surface of the spores, and especially in the presence of groups of sterile cells between the spore balls in *S. aristidicola*.

Winter (1883a:2 and 1883b:7) described *Sorosporium ellisii* G. Winter, indicating two syntypes, one on *Andropogon virginicus* L., the other on *Aristida dichotoma* Michaux. Jackson (1908) found the two syntypes specifically distinct. He designated the specimen on *Andropogon* as the lectotype of *S. ellisii*, and for the *Aristida* smut proposed the name of *S. confusum*. Both these smut fungi belong to the genus *Sporisorium*.

5. ***Sporisorium confusum*** (H. S. Jackson) Vánky, **comb. nov.**

Basionym: *Sorosporium confusum* H. S. Jackson, Bull. Torrey Bot. Club 35:148, 1908. — Type on *Aristida dichotoma* Michaux, USA, Delaware, Newark, X.1907, H. S. Jackson, BPI 179549!

Sori in the ovaries, elongated with acute tip, 0.5–1.5 x 1.5–4 mm, enclosed by the enveloping glumes, covered by the pericarp which ruptures at maturity disclosing the granular-powdery, blackish-brown mass of spore balls. *Spore balls* subglobose, ovoid, ellipsoidal, elongated or irregular, 30–70 x 40–100 µm, reddish-brown, composed of 15–80 (or more?) spores which separate easily by pressure. *Spores* slightly dimorphic, subpolyhedrally irregular, rarely ellipsoidal, 9–12.5 x 10–15 µm, yellowish-brown, inner spores more angular, slightly paler; wall even or nearly so, 0.5–1(–1.5) µm thick, inner spores sparsely, outer spores densely verrucose-echinulate, warts up to 0.5 µm high; spore profile of the free surface finely serrulate. *Sterile cells* absent.

On *Aristida adscensionis* L., *A. barbata* Fourn., *A. dichotoma* Michaux, *A. divaricata* Humb. & Bonpl. ex Willd., *A. hamulosa* Henrard, *A. inaequiglumis* Domin, *A. jerichoensis* (Domin) Henrard, *A. jorullensis* Kunth, *A. longespica* Poiret, (*A. gracilis* Ell.), *A. pansa* Woot. & Standl., *A. purpurea* Nutt., *A. purpurascens* Poiret, *A. scabrivalvis* Hackel, *A. schiediana* Trin. & Rupr. (*A. orcuttiana* Vasey), *A. spiciformis* Ell., *A. stricta* Michaux, *A. ternipes* Cav., *A. vagans* Cav., *A. wrightii* Nash; N. & S. America (USA, Mexico, Argentina), Australia. **Obs**. Host plant list based partly on data from the literature and should be confirmed.

Sporisorium confusum has larger, more evidently ornamented spores than *S. consanguineum*. It is close to *S. goniosporum* in which the spores are dark reddish-brown, the wall uneven, 0.5–2.5 µm thick, densely verrucose-echinulate.

6. *Sporisorium consanguineum* (Ellis & Everh.) Vánky, 1988a:402, s. lat. *Sorosporium consanguineum* Ellis & Everhart, 1887:56. — Type on "*Aristida rusbyi* Scribn." (*A. arizonica* Vasey), USA, N. Arizona, leg. Rusby, BPI 179664!

Ustilago aristidae Peck, 1885:35 (not *Sporisorium aristidae* (S. Ahmad) Vánky). — Type on *Aristida* sp., USA, Texas, El Paso, September, coll. M. E. Jones, BPI 157309.

Sorisporium aristidae Neger, 1896:789. — Type on *Aristida pallens* Cav., Chile, Bio-Bio Prov., Angol, IX.1896, F. W. Neger. Holotype destroyed in Berlin (B). Neotype (designated here) in BPI 195114!, isotype in BPI 179446!

Sorosporium bornmuelleri Magnus, 1900:434 (as "*Sorisporium*"). — Type on *Aristida coerulescens* Desf. (= *A. adscensionis* L.), Libanon (Syria), near Burmmana, alt. 600-700 m., VII.1897, J. Bornmüller. Holotype in HBG 988!, isotypes in BPI 179558! & Bornmüller, Iter Syriacum, 1897, no. 988, HUV 1653!

Sori in the ovaries, swollen, asymmetrically ovoid-fusiform, 0.5–2.5 x 3–6 mm, more or less hidden by floral envelopes, covered by the pericarp which ruptures at maturity disclosing the blackish-brown, first agglutinated later granular-powdery mass of spore balls, or the sori fall off the plants unopened. No columella. The spore balls are produced from sporogenous hyphae on that side of the seeds where the raphe is situated (comp. Magnus, 1900:434, Pl. 3, fig. 11). Young spore balls are surrounded by concentrically arranged, hyaline hyphae. *Spore balls* variable in shape and size, globose, subglobose, ellipsoidal, elongated to subpolyhedral or irregular, 20–80 x 25–110(–130) µm (in some collections 25–50 or 40–140 µm long), reddish-brown to opaque, composed of tens of spores which separate easily by pressure. *Spores* not or only slightly dimorphic, subpolyhedrally irregular, rarely subglobose or broadly ellipsoidal, 5.5–9 x 6.5–10.5 µm, yellowish- to reddish-brown; wall evenly or slightly unevenly thick (c. 0.5 µm) nearly smooth to finely verruculose, more expressly on the exposed surface just affecting the spore profile. *Sterile cells* lacking.

On *Aristida adscensionis* L. (*A. caerulescens* Desf.), *A. arenaria* Gaud., *A. arizonica* Vasey (*A. rusbyi* Scribner), *A. armata* Henrad, *A. barbata* Fourn., *A. basiramea* Englm., *A. behriana* Mueller, *A. benthami* Henrad, *A. circinalis* Lindl. (*A. caerulescens* Desf.), *A. complanata* Trin., *A. divaricata* Humb. & Bonpl. ex Willd., *A. glauca* (Nees) Walp., *A. glumaris* Henrad, *A. heterochaeta* Henrad, *A. hystrix* L. fil., *A. junciformis* Trin. & Rupr., *A. laxa* Cav., *A. leptopoda* Benth., *A. longiseta* Steudel (*A. purpurea* Nutt.), *A. longiseta* Steudel var. *robusta* Merr., *A. murina* Cav., *A. pallens* Cav., *A. pansa* Woot. & Standl., *A. plumosa* L., *A. psammophila* Henrard., *A. purpurascens* Poiret, *A. ramosa* R. Br., *A. schiediana* Trin. & Rupr. (*A. orcuttiana* Vasey), *A. ternipes* Cav., *A. uruguayensis* Henrard, *A. vagans* Cav.; world-wide, in the tropics and subtropics (Africa, Asia, Australia, N., C. & S. America). **Obs**. Host plant list based partly on data from the literature and should be confirmed.

7. ***Sporisorium fraserianum*** (H. Sydow) Vánky, **comb. nov.**

Basionym: *Sorosporium fraserianum* H. Sydow, Ann. Mycol. 35:25, 1937. — Type on *Aristida leptopoda* Benth, Australia, New South Wales, Warialda, I.1932, L. Fraser 121, IMI 44415 ex Univ. of Sydney, HUV 17480!

Sori in the ovaries, inconspicuous, ovoid or asymmetrically fusiform, 1–1.5 x 2–6 mm, partly hidden by the floral envelopes, covered at first by a green, later brown pericarp which at maturity ruptures on its sides disclosing the blackish-brown, powdery mass of spore balls and spores. Usually all ovaries of the inflorescence are affected but some ovaries or inflorescence branches may escape infection. No columella, no sterile cells. *Spore balls* irregular, 35–60 µm (or larger?), easily disintegrating. *Spores* globose, subglobose, ellipsoidal or slightly subpolyhedrally irregular, rather uniform in size, 4.5–6(–6.5) x 5.5–8 µm, yellowish-brown; wall c. 0.5 µm thick, finely, densely punctate-verruculose, the warts are usually more pronounced on one side or in a restricted area of the spore surface, where the spore profile may be finely serrulate, the opposite side of the spores may be nearly smooth.

On Gramineae: *Aristida caput-medusae* Domin, *A. leptopoda* Benth., and *A. personata* Henrard (on which the spores are c. 1 µm larger); Australia.

Sporisorium fraserianum is close to *S. consanguineum* but in *S. fraserianum* the spore balls are looser, the spores smaller and less polyhedral than those in *S. consanguineum.*

8. ***Sporisorium goniosporum*** (Massee) Vánky, **comb. nov.**

Basionym: *Ustilago goniospora* Massee, Bull. Misc. Inform. 1899:183, 1899b. — *Sorosporium goniosporum* (Massee) L. Ling, 1953a:189. — Type on *Aristida* sp. (= *A. adoensis* Hochst.), Kenya, Ukamba, coll. Scott-Elliott 6491, K, HUV 15442!

Sori in the ovaries, inconspicuous, fusiform-ellipsoid, c. 1 x 3–4 mm, hidden by the enveloping glumes and enclosed by a thin peridium which ruptures at maturity disclosing the blackish-brown, granular-powdery mass of spore balls and spores. *Spore balls* subglobose, ovoid to slightly irregular, 30–60 x 35–75 µm, dark reddish-brown to opaque, composed of tens of loosely arranged spores which separate by pressure. *Spores* not dimorphic, ovoid, ellipsoidal or subpolyhedral, 10–14 x 11–16 µm, reddish-brown; wall unevenly thick, 0.5–2.5 µm, thickest at the angles and on the free surface, densely verrucose-echinulate, warts 0.5–0.8 µm high; spore profile rough to serrulate. *Sterile cells* absent.

On *Aristida adoensis* Hochst.; Africa (Kenya).

Sporisorium goniosporum is close to *S. consanguineum* but in *S. goniosporum* the spores are larger, the spore wall is unevenly thick, and the free surface of the spores is densely verrucose-echinulate. The dark violet colour of the sori and spores given in the original description of *S. goniosporum* is erroneous.

9. *Tilletia oklahomae* Zundel, 1939:586.

Type on *Aristida longespica* Poiret, USA, Oklahoma, Tulsa, XI.1937, H. G. Barclay. Lectotype (designated here) in BPI 173621! Isotypes in BPI 173622! & 195165!

Sori in all ovaries of an inflorescence, inconspicuous, concealed by the glumes, 1 x 2–4 mm, covered by the delicate pericarp which ruptures irregularly disclosing the reddish-brown, semiagglutinated to powdery mass of spores and sterile cells. *Spores* globose, subglobose to ellipsoidal, 16–21.5 x 17.5–23 µm, yellowish-brown, endospore even, c. 0.5 µm thick, exospore provided with coarse, subconical, 2.5–4 µm high warts. *Sterile cells* rather abundant, globose, ellipsoidal, ovoid to slightly irregular, variable in size, 10–18(–20) x 10–20(–23) µm, pale yellow, content granular, wall 1.5–3 µm thick, smooth.

On *Aristida longespica* Poiret; N. America (USA).

10. *Tilletia palpera* J. Walker & Vánky, **sp. nov.**

Typus in matrice *Aristida* sp., Australia, Queensland, Cunnamulla, V.1955, leg. A. Johnson. Holotypus in BRIP 7812 (as *T. palpera* J. Walker & Langdon, nom. herb.), isotypus in Herbario Ustil. Vánky, HUV 18647! Paratypi in matrice *Aristida* sp., Queensland, 25 km N Charleville, 'Maxvale' Station, IX.1983, leg. A. J. Pressland, BRIP 14048, DAR, HUV 18646! et in matrice *Aristida glumaris* Henrard (= *A. calycina* R. Br.), Queensland, Camp Mountain, 7.IV.1940, leg. S. T. Blake, IMI 43755, HUV 18917!

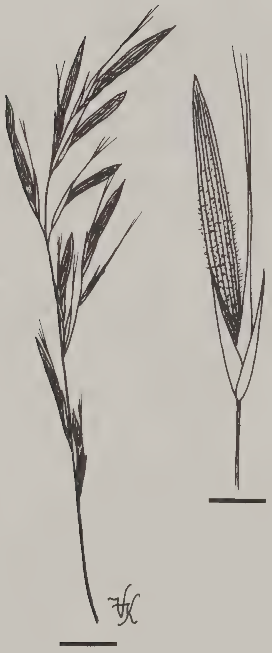
Sori in omnibus ovariis eiusdem inflorescentiae, aliquantum hypertrophici, fusiformes usque longe cylindrici, cum apice acuto, 1–1,5 x 10–20 mm (in *Aristida calycina* 1 x 60–70 mm), pallide brunnei, maturitate longitudinaliter rupti folium gracile simulantes, massam flavidobrunneam, semiagglutinatam usque pulveream sporarum et cellularum sterilium ostendentes. *Sporae* globosae, subglobosae usque late ellipsoidales, 14–19 x 15–20(–21) µm (in *Aristida calycina* 12–17 x 12–18 µm), pallide usque mediocriter flavidobrunneae, endosporio aequali, cca. 0,5 µm crasso, exosporio cum verrucis 1–2,5 µm altis, obtusis vel subacutis; imago obliqua sporae undulata. *Cellulae steriles* globosae, ellipsoidales usque parum irregulares, 12–21 x 13–25(–32) µm, flavae, usque pallide flavidobrunneae; pariete 2,5–4(–5) µm crasso, levi, saepe multilaminato, contentu granuloso.

Sori (Fig. 35) in all ovaries of the inflorescence, considerably hypertrophied, fusiform to long cylindrical with acute tip, 1–1.5 x 10–20 mm (on *Aristida calycina* 1 x 60–70 mm), pale brown, at maturity they rupture longitudinally and open, resembling a thin leaf, disclosing the yellowish-brown, semiagglutinated to powdery mass of spores and sterile cells. *Spores* (Figs. 36, 37) globose, subglobose to broadly ellipsoidal, 14–19 x 15–20(–21) µm (on *Aristida calycina* 12–17 x 12–18 µm), pale to medium yellowish-brown, endospore even, c. 0.5 µm thick, exospore provided with 1–2.5 µm high, blunt to subacute warts; spore profile wavy. *Sterile cells* (Fig. 36) globose, ellipsoidal to slightly irregular, 12–21 x 13–25(–32) µm, yellow to pale yellowish-brown; wall 2.5–4(–5) µm thick, smooth, often multilaminated, content granular.

On *Aristida calycina* R. Br. (*Aristida glumaris* Henrard), and *Aristida* sp.; Australia, South Africa.

The covering of the sorus is composed entirely of host tissue (modified pericarp), with several parallel vascular bundles, hairy on the inner side towards the lumen.

Etymology: *palpera* = leaf, in a language of the aboriginal people of Central Australia, referring to the appearance of the opened sorus.



35

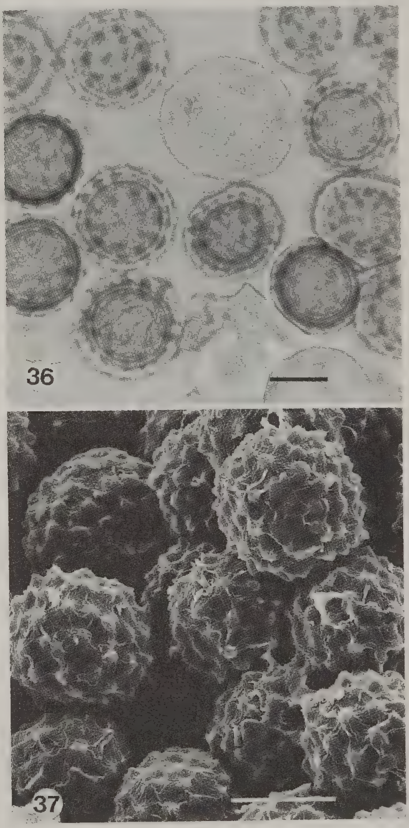


Fig. 35. Sori of *Tilletia palpera* J. Walker & Vánky in the ovaries of *Aristida* sp. (type). Enlarged an opened sorus with longitudinal, finely hairy veins, resembling a leaf. Bars = 1 cm for the habit, 4 mm for the detail drawing.

Figs. 36, 37. Spores of *Tilletia palpera* on *Aristida* sp., in LM and in SEM (type). Bars = 10 µm.

11. *Ustilago aristidarius* Durán, 1987:222.

Type on *Aristida adscensionis* L., Mexico, Durango, 8.5 mi N of Gabriel Hernández, alt. 1829 m., 30.X.1978, R. Durán & P. M. Gray. Holotype in WSP 67751, isotype in HUV 14490!

Sori in some ovaries of the inflorescence, fusiform to asymmetrically swollen and slightly bent, 0.5–1 x 2–5 mm, covered by the initially green later brown pericarp which easily ruptures to expose the chocolate brown, semiagglutinated spore mass. No columella, no spore balls, no sterile cells. *Spores* globose, subglobose, ovoid, ellipsoidal, laterally slightly compressed, rarely irregular with a subacute tip on one end, 6.5–8 µm wide, in facial view 8–9.5 x 8–12 µm, yellowish-brown; wall evenly thick (0.5–0.8 µm), moderately densely verruculose; spore profile nearly smooth to very finely serrulate.

On *Aristida adscensionis* L., *A. divaricata* Humb. & Bonpl. ex Willd., *A. hamulosa* Henrard, *A. ternipes* Cav.; N. America (Mexico).

Ustilago aristidarius represents an extreme form of the *Sporisorium consanguineum* complex in which none of the characters of a *Sporisorium* is present (no peridium, columella, spore balls, or sterile cells). This is one of the many examples which demonstrate that the limits between *Ustilago* and *Sporisorium* are not sharp, both genera being still heterogeneous.

Sorosporium maroccanum is *Ustilago bromivora*

Sorosporium maroccanum Unamuno, 1940:103. — Type on "*Aristida adscensionis* L." (= misnamed *Brachypodium distachyon* (L.) Beauv., teste K. Vánky), Morocco, at the mouth of the river Isli, near Axdir, 15.V.1927, P. Font Quer, MA 10964!, is *Ustilago bromivora* (L.-R. & C. Tul.) A. A. Fischer Waldh. — Lectotype on *Bromus secalinus* L.

Ustilago aristidicola is *Sporisorium microsporum*

Ustilago aristidicola Hennings, 1908:266. — Type on "*Aristida* sp." (= misnamed *Paspalum brunneum* Mez, teste H. Scholz, B), Brazil, Estado de Bahia, Maracás, IX.1906, E. Ule 3316. Holotype in HBG 3316!, isotypes in BPI 157312!, 196307! and in FH.

The study of the type specimen revealed that this fungus is identical with the earlier described *Ustilago microspora* J. Schröt. & Henn., in Hennings, 1896:215, = *Sporisorium microsporum* (J. Schröt. & Henn.) M. Piepenbr. — Type on *Paspalum* sp., Brazil.

Species of uncertain affinity

Ustilago bornmuelleri Magnus, 1896:427.

Type on *Aristida ?caloptila* Jaub. & Spach (= *Aristida ?paradisea* Edgew.), Arabia, Bahrein Island in Persian Gulf, 1.III.1893, J. Bornmüller 1968, HBG!

Sori in the inflorescence of stunted host plants, cylindrical, c. 1 cm long, initially covered by a whitish peridium. *Spores* globose to ellipsoidal, 6.5–10 x

7–11 µm, reddish-brown, finely verrucose-echinulate, spore profile finely serrulate.

The identity of the host plant is uncertain. Most probably it is not an *Aristida*, but with the lack of a healthy plant, this could not be proved by study of the type specimen. The fungus belongs to the genus *Sporisorium*.

Key to the smut fungi of Aristideae (*Aristida* and *Stipagrostis*)

1. Spores more than 15 µm long 2
– Spores less than 15 µm long 3
2. Sori 2–4 mm long. Spores 17.5–23 µm long, provided with 2.5–4 µm high warts .... *Tilletia oklahomae*
– Sori 10–20 mm or longer. Spores 15–20(–21) µm long, provided with 1–2.5 µm high warts .... *Tilletia palpera*
3. Sori in ovaries 5
– Sori elsewhere 4
4. Sori in culms and/or spikelets. Spore balls rather permanent. Free surface of outer spores coarsely verrucose-echinulate ...... *Sporisorium aristidae*
– Sori destroying the whole inflorescence. Spore balls ephemeral. Free surface of outer spores finely punctate-verruculose .... *Sporisorium aristidae-lanuginosae*
5. Sori 5–25 mm long. Spores in irregular groups of "pseudo spore balls" .... *Macalpinomyces aristidae-cyananthae*
– Sori less than 6 mm long. Spores in ephemeral or permanent spore balls or spores single 6
6. Spores globoid, laterally slightly compressed, single .... *Ustilago aristidarius*
– Spores more or less angular, in ephemeral, loose or permanent spore balls 7
7. Sori bullate, evident, covered by a thick, persistent peridium. Spore balls rather permanent. Groups of sterile cells present between the spore balls .... *Sporisorium aristidicola*
– Sori fusiform, more or less hidden by floral envelopes, covered by a thin peridium. Spore balls loose or ephemeral. Sterile cells lacking 8
8. Spores 10–16 µm long 9
– Spores smaller 10
9. Spores subpolyhedrally irregular, yellowish-brown. Spore wall even or slightly uneven, 0.5–1(–1.5) µm thick .... *Sporisorium confusum*
– Spores rounded or subpolyhedral, reddish-brown. Spore wall uneven, 0.5–2.5 µm thick .... *Sporisorium goniosporum*
10. Spores distinctly dimorphic. Free wall up to 3 µm thick, prominently verrucose-echinulate, warts 1–2(–2.5) µm high .... *Sporisorium* sp.
– Spores not or only slightly dimorphic. Free wall c. 0.5 µm thick finely verruculose 11
11. Spore balls ephemeral. Spores rounded or subpolyhedral, mostly 5.5–8 µm long .... *Sporisorium fraserianum*
– Spore balls loose to semi-permanent. Spores mostly subpolyhedral or polyhedral, 6.5–10.5 µm long .... *Sporisorium consanguineum*

CONIDIOSPOROMYCES AND *TILLETIA* OF *SETARIA* (GRAMINEAE)

The genus *Conidiosporomyces Vánky* was introduced for *Tilletia ayresii*, based especially on the presence of balls of hyaline, Y-shaped conidia between the spores (Vánky & Bauer, 1992). Soon, a second species was transferred into this genus, *C. verruculosus* (Wakef.) Vánky (1993:39). Recently, it turned out that *Tilletia echinosperma* Ainsw. also belongs to this genus as a separate species. Species of *Conidiosporomyces* are restricted to host plants in the genera *Setaria* and *Panicum*. There is a rather expressed variability in most characters of the species of *Conidiosporomyces* (e.g. colour of the spore mass and spores, size of the spores and their ornamentation, type of spore ornamentation, presence of balls of conidia between the spores, etc.). Despite this variability, and taking into consideration all characters, it is usually no problem to assign a specimen to one of the three *Conidiosporomyces* species. The sole, and not satisfactorily solved problem, is that of *Ustilago evansii* Henn. (type on *Setaria aurea*, South Africa). It certainly belongs to *Conidiosporomyces*. The extremely scanty material I have seen did not allow a sure decision. Most probably it represents *C. ayresii* (see the original description by Hennings, 1908:270).

On *Setaria* at least nine *Tilletia* species have been reported. Of these *T. echinosperma* Ainsw. is a *Conidiosporomyces*, *T. magnusiana* A. A. Fischer Waldh. is a *Sporisorium*, *T. makutensis* Thirum. & Safeeulla is *T. setariae* (see also Durán & Fischer, 1961:103), and *T. eleusines* H. Sydow is restricted to its type host, *Dactyloctenium aegyptium* (L.) Beauv. A *Tilletia* on *Setaria viridis* in China turned out to differ from *T. setariae*, to which it was attributed earlier. It is described as a new species. Consequently, on *Setaria* three *Conidiosporomyces* and six *Tilletia* species are recognised.

1. *Conidiosporomyces ayresii* (Berk.) Vánky, in Vánky & Bauer, 1992:429. *Tilletia ayresii* Berk., in Massee, 1899a:146. — Type on *Panicum maximum* Jacq., Mauritius, hills above Port Louis, coll. P. B. Ayres 4754, Herb. Berk. in K.

Ustilago heterospora Hennings, 1895:48 (later homonym, not Niessl, 1872). — *Tilletia heterospora* (Henn.) Zundel, 1938:310. — Type on *Panicum maximum* Jacq., Tanganyka Territory (Tanzania), Sk., Amboni, coll. C. H. E. W. Holst 2765.

Ustilago evansii Hennings, 1908:270. — Type on *Setaria aurea* A. Br. (= *S. sphacelata* (Schumacher) Moss var. *aurea* (A. Br.) W. D. Clayton), South Africa, Transvaal, Tzaneen, Zoutpansberg, 9.IV.1906, coll. J. Brutt Davy, comm. I. B. Pole-Evans, PREM 10! BPI 160415! & 160421!

Sori in some ovaries of an inflorescence, swollen, globose, ovoid or cylindrical, 1.5–3 x 2.5–5(–10) mm, composed of an apically open, sac-like, leathery membrane and a grey to pale olivaceous-brown, semi-powdery central mass of spores, sterile cells, immature spores and balls of conidia. Columella absent. *Spores* globose, subglobose to broadly ellipsoidal, 12–16 x 13–17 µm, yellowish-brown to dark brown, finely to coarsely verrucose, warts (0.5–)1–2 µm high, subacute or flattened. *Sterile cells* few, smooth, hyaline, about the size of the spores. "*Immature spores*" abundant, globose or ellipsoidal, variable in size, usually collapsed, 13.5–20 x 14.5–21.5 µm, hyaline, wall relatively thin (1.5–2 µm), finely, sparsely to densely verrucose-echinulate. *Balls of conidia* globoid, 25–55 µm in diameter, composed of many, more or less loosely connected, hyaline conidia. *Conidia* variable in shape, usually Y-shaped, but also triangular, T-, club- or boomerang-shaped, often with two rounded and widened branches and one gradually narrowing to pointed branch, 10–16(–20) µm long, 2.5–3 µm wide. (For detailed description and illustration of germination, culture characters, ultrastructure, etc., see Vánky & Bauer, 1992).

On *Panicum maximum* Jacq., *P. megastachyum* Nees, *P. parvifolium* Lam., *P. schinzii* Hack. (*P. laevifolium* Hack.), *Setaria pallide-fusca* (Schumacher) Stapf & C. E. Hubb., *S. paniculifera* (Steudel) Fourn. (*Panicum paniculiferum* Steudel), ?*S. sphacelata* (Schumacher) Moss var. *aurea* (A. Br.) W. D. Clayton (*S. aurea* A. Br.). (Probably also on further *Panicum* and *Setaria* species. However, several host plants given for *C. ayresii*, refer to *C. echinospermus* or *C. verruculosus*); Tropical and subtropical Africa, Asia and C. & S. America, especially on its principal host plant, *P. maximum*.

Durán & Fischer (1961:33) considered *Tilletia hyparrheniae* L. Ling (1953b:151; type on *Hyparrhenia subplumosa* Stapf, Sierra Leone, Musaia, 15.XII.1946, F. C. Deighton M 2553, IMI 11370!) to be a synonym of *T. ayresii*. The study of two slides of the type specimen could not confirm this. In *T. hyparrheniae* conidia are absent, and the spores are much larger, measuring (22-)26–32(–36) µm. It is considered by me to be a separate species.

2. *Conidiosporomyces echinospermus* (Ainsw.) Vánky, **comb. nov.**

Basionym: *Tilletia echinosperma* Ainsworth, Proc. Linn. Soc. London 153:95, 1941. — Type on *Setaria sphacelata* (Schumacher) Moss, Uganda, West Nile, Kajomoro, VI.1936, A. S. Thomas U1995, IMI 42354!

Sori, Y-shaped *conidia* and *immature spores* as in *C. ayresii* but differs from it in the size and ornamentation of the spores. The spores of *C. echinospermus* are 14.5–21 µm long (in some specimens longer, 16–23 µm), provided with mainly 1.5–3(–4) µm long, 0.5 µm wide, filiform warts, giving a peculiar, sun-like appearance to the spores seen in optical median view. In surface view, the tops of the ornamentation appear as densely situated, small, dark spots.

On *Setaria barbata* (Lam.) Kunth, *S. incrassata* (Hochst.) Hack. (*S. perberbis* de Wit.), *S. longiseta* Beauv., *S. pallide-fusca* (Schumacher) Stapf & C. E. Hubb., *S. sphacelata* (Schumacher) Moss, *S. sphacelata* var. *aurea* (A. Br.) W. D. Clayton (*S. aurea* A. Br., *Setaria trinervia* Stapf), *S. sphacelata* var. *splendida* (Stapf) W. D. Clayton (*S. splendida* Stapf); Africa.

3. *Conidiosporomyces verruculosus* (Wakef.) Vánky, 1993:39.

Ustilago verruculosa Wakefield 1922:162. — Type on *Setaria aurea* A. Br. (= *S. sphacelata* (Schumacher) Moss var. *aurea* (A. Br.) W. D. Clayton), Congo, I.1914, H. Vanderyst 5054, Herb. K!

The sori of *C. verruculosus* and *C. ayresii* are similar. In *C. verruculosus* the spore mass is dark brown (not pale brown or greyish), between the spores are relatively few immature spores and conidia, the 14–18(–21) µm long spores are provided with predominantly coarse, 1–2(–2.5) µm long, conical, acute or subacute spines, 0.5–1 µm wide at their base.

On *Setaria incrassata* (Hochst.) Hack. (*S. mombassana* Herrm.), *S. pallide-fusca* (Schumacher) Stapf & C. E. Hubb., *S. sphacelata* (Schumacher) Moss, *S. sphacelata* var. *aurea* (A. Br.) W. D. Clayton (*S. aurea* A. Br.), *S. sphacelata* var. *sericea* (Stapf) W. D. Clayton (*S. tenuispica* Stapf & C. E. Hubb.); Africa.

4. ***Tilletia setariae*** L. Ling, 1945:2.

Neovossia setariae (L. Ling) T. F. Yu & L. H. Lou, 1957:47. — Type on *Setaria lutescens* (Weigel) F. T. Hubb., China, Szechwan Prov., Chengtu, 20.X.1942, L. Ling, IMI 499!

Tilletia makutensis Thirumalachar & Safeeulla, 1951:440. — Type on *Setaria pallide-fusca* (Schumacher) Stapf & C. E. Hubb., India, Mysore, Coorg distr., Makut, 15.X.1950, K. M. Safeeulla, isotypes in HUV 16371! and IMI 48263.

Sori in some of the ovaries of a panicle, protruding between the floral envelopes as obovoid or ovoid bodies, often acute at one end, 1–3 x 2–5 mm, covered by a first green, later brown membrane of host origin (pericarp) which ruptures irregularly to disclose the black, powdery mass of spores intermixed with sterile cells. *Spores* globose, subglobose to broadly ellipsoidal, 21–28 x 24–33 µm, yellowish- to dark chocolate-brown and subopaque, provided with 1.5–2.5 µm high, coarse, subconical warts, in surface view appearing as small, polygonal areas, 8–13 per spore diam. *Sterile cells* few, variable, subglobose, ellipsoidal to irregular, 13–22 µm long, hyaline to pale yellow; wall 1.5–3 µm thick, smooth.

On *Setaria glauca* (L.) Beauv., *S. lutescens* (Weigel) F. T. Hubb., *S. pallide-fusca* (Schumacher) Stapf & C. E. Hubb. ex Moss, *S. viridis* (L.) Beauv.; E. & S. Asia (China, India).

5. ***Tilletia setariae-palmifoliae*** Mishra, 1956:873.
(as "*setariae-palmiflorae*").

Type on *Setaria palmifolia* (Koenig) Stapf (issued as *S. palmiflora*), India, Bihar, Parasnath, alt. 3500 ft, 13.X.1953, J. N. Mishra. Isotypes in BPI 173839!, HUV 17364!, IMI 60479.

Sori in some hypertrophied ovaries of a panicle, 1–3 x 3–5 mm, opening apically to release the black, powdery mass of spores intermixed with sterile cells. *Spores* globose to subglobose, 16–23 x 16–24 µm, reddish-brown; wall 2–3 µm thick including the c. 1 µm high, subacute, delicate, densely situated verrucae embedded in a hyaline sheath, in surface view appearing as minute, dark, polyangular areas often arranged in rows. *Sterile cells* globose, ovoid to slightly irregular, 16–26 µm long, pale yellowish-brown, content granular; wall thick, 2–4.5 µm, homogenous or finely many-layered, smooth.

On *Setaria palmifolia* (Koenig) Stapf; S. Asia (India). Known only from the type locality, in the Parasnath hills, where it is abundant.

Mishra (1956:873) published "*Tilletia setariae-palmiflorae*" on "*Setaria palmiflora*". A grass with this name does not exist. It is an incorrect spelling of *S. palmifolia* (Koenig) Stapf. Mishra obviously based the specific epithet of his new species on the incorrectly spelled host plant. The name "*setariae-palmiflorae*" is misleading and can be considered as a typographic error which has to be corrected (ICBN Art. 60.1). Consequently, the spelling should be as given above, *Tilletia setariae-palmifoliae*.

6. *Tilletia setariae-viridis* Vánky, sp. nov.

Typus in matrice *Setaria viridis* (L.) Beauv., Sina, Beijing, 39°46' N, 116°20' E, alt. cca. 50 m, 22.IX.1979, leg. Z. Y. Zhao et al. Holotype in HMAS 38724, isotypi in Herbario Ustil. Vánky, HUV 9528, et in Vánky, Ustil. exs. no. 292 (sub *T. setariae* L. Ling). Paratypus Beijing, "Yuanmingyuan", 40°00' N, 116°16' E, alt. cca. 100 m, 2.X.1985, leg. L. Guo & Vánky, HMAS 50057!, HUV 11706!

Sori in nonnullis ovariis eiusdem paniculi, eos tumefacientes, 1,5–3 x 2–6 mm, membrana origine hostali initio viridi, serius brunnea, levi, non hispida (pericarpio) cooperti, qua irregulariter rupta massam sporarum nigrescenti-brunneam, pulveream et cellulas steriles ostendentes. *Sporae* globosae, subglobosae usque late ellipsoidales, 20–25 x 22,5–28 µm, flavidobrunneae; pariete 2,5–3 µm crasso, cum verrucis 1,5–2,5 µm altis, delicatis, acutis, in visu surfaciali sicut areae parvae, polygonales, 11–17 per diametrum sporae apparentibus. Nonnullae sporarum forte cum papilla hyalina vel cum appendice angusta, hyalina instructae. "Sporae immaturae" incoloratae, cum vestigiis ornamenti (punctatae usque verrucosae) praesentes. *Germinatio sporarum* cum holobasidio brevi, apice verticillum basidiosporarum pluries decem (60–80?), acicularium, dicaryoticum, sine fusione hyphas producentium. *Cellulae steriles* globosae, ellipsoidales, raro limoniiformes vel parum irregulares, 10–24 µm longae, hyalinae, nonnunquam cum appendice; pariete 1,5–3 µm crasso, homogeneo vel indistincte multistratoso, levi, sub SEM aspero.

Sori (Fig. 38) in some of the ovaries of a panicle, hypertrophied, 1.5–3 x 2–6 mm, covered by an initially green later brown, smooth, non hispid membrane of host origin (pericarp) which ruptures irregularly to disclose the blackish-brown, powdery mass of spores and sterile cells. *Spores* (Figs. 39, 40) globose, subglobose to broadly ellipsoidal, 20–25 x 22.5–28 µm, yellowish-brown; wall 2.5–3 µm thick, provided with 1.5–2.5 µm high, delicate, acute warts which in surface view appear as small, polygonal areas, 11–17 per spore diameter. Some of the spores may have a hyaline papilla or a narrow, hyaline appendage. Colourless, "immature spores", with trace of ornamentation (punctate to verrucose) are present. *Spore germination* (Fig. 41) results in a short holobasidium bearing apically a whorl of tens (60–80?) of acicular, dikaryotic basidiospores which without fusing germinate by hyphae. *Sterile cells* (Figs. 39, 40) globose, ellipsoidal, rarely lemon-shaped or slightly irregular, 10–24 µm

40) globose, ellipsoidal, rarely lemon-shaped or slightly irregular, 10–24 µm long, hyaline, sometimes with an appendage; wall 1.5–3 µm thick, homogenous or indistinctly multilayered, smooth, in SEM rough.

On *Setaria viridis* (L.) Beauv.; E. Asia (China). Common around Beijing.

7. ***Tilletia setaricola*** Pavgi & Thirumalachar, 1952:321.

Type on *Setaria intermedia* (Roth) Roem. & Schult. (= *S. tomentosa* (Roxb.) Kunth), India, Uttar Pradesh, Benares (Varanasi), 15.IX.1950, M. S. Pavgi, BPI 173840. Topotype 5.X.1992, C. & K. Vánky, HUV 16084!

Sori in some of the hypertrophied ovaries of a panicle, globose to ovoid, protruding between the floral envelopes, 2–4 mm long, covered by a thick, pubescent, brownish membrane which ruptures irregularly exposing the black, powdery mass of spores intermixed with sterile cells. *Spores* globose, subglobose to broadly ellipsoidal, 17.5–21 x 18–23 µm, reddish-brown, reticulate, 4–5 meshes per spore diam., muri 1.5–2.5 µm high. *Sterile cells* globose, subglobose to broadly ellipsoidal, variable in size, 10–28 µm long, hyaline or subhyaline; wall 1.5–4 µm thick, smooth.

On *Setaria tomentosa* (Roxb.) Kunth (*S. intermedia* (Roth) Roem. & Schult.), *S. verticillata* (L.) Beauv.; S. Asia (India, Pakistan).

Tilletia setaricola is close to *T. eleusines* H. Sydow (type on *Dactyloctenium aegyptium* (L.) Beauv., India) with which it was merged by Durán & Fischer (1961:59). However, there are enough differences between the two to consider them as two different species. In *T. eleusines* the spores are lighter coloured, there are (4–)5–6 meshes per spore diam., and the muri are 1–1.5 µm high.

8. ***Tilletia thirumalachari*** Gandhe, in R. V. & K. Gandhe, 1999:299.

Type on *Setaria verticillata* (L.) Beauv. (= misnamed *S. tomentosa* (Roxb.) Kunth, teste Vánky), India, Maharashtra State, Pune, 10.X.1974, R. V. Gandhe, HCIO 33476!

Sori in a few ovaries of a panicle, slightly hypertrophied, c. 2 mm in diam., more or less concealed by the glumes, covered by a first dirty green, later brown membrane of host origin (pericarp) which ruptures from its apex disclosing the black, powdery mass of spores intermixed with sterile cells. *Spores* globose to subglobose, 13–18 x 13–19(–22) µm, from olivaceous-brown to dark reddish-brown and almost opaque, provided with densely situated, c. 1 µm high, blunt verrucae, in surface view appearing as small, dark, polyangular areas, rarely also a short, hyaline papilla attached to the spore can be seen. *Sterile cells* subglobose to ellipsoidal or slightly irregular, 10–22 µm long, subhyaline to pale yellowish-brown, content granular; wall 1–1.5 µm thick, smooth.

On *Setaria tomentosa* (Roxb.) Kunth (*S. intermedia* (Roth) Roem. & Schult.); S. Asia (India).

T. thirumalachari is close to *T. setariae* and *T. setariae-palmifoliae*. However, in *T. setariae* the spores and spore ornamentation are larger (spores 21–33 µm long, warts 1.5–2.5 µm high). In *T. setariae-palmifoliae* the spores are larger (16–24 µm long), but the warts are more delicate, and the wall of the sterile cells is much thicker (2–4.5 µm).

9. ***Tilletia zundelii*** Hirschhorn, 1943:186.

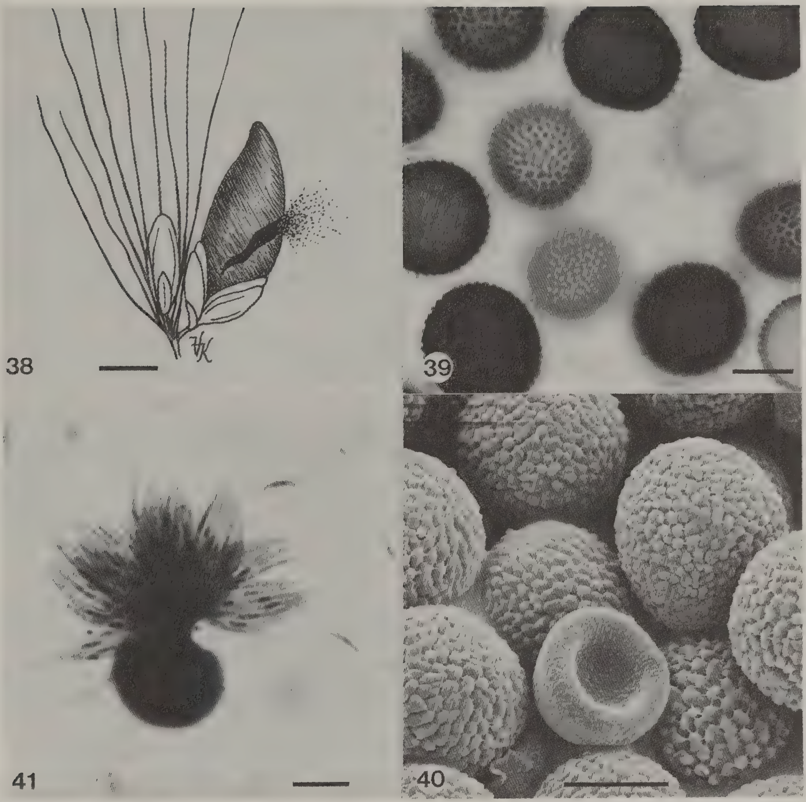
Type on *Setaria argentina* (Herrm.) Hitchc., Argentina, Chaco, Presidente Sáenz Peña, 1941, J. Báez, Herb. E. Hirschhorn no. 901.

Sori in some flowers of a panicle, considerably hypertrophied, comprising the ovaries and inner floral organs, 3–4 x 4–11 mm, covered by a thick, pubescent, brownish membrane which ruptures irregularly exposing the black, powdery mass of spores intermixed with sterile cells. *Spores* globose, subglobose, rarely broadly ellipsoidal, 13–18 x 13–18 µm, pale to dark reddish-brown, with densely situated, 1–2 µm high flattened warts. *Sterile cells* globose to broadly ellipsoidal, usually larger than the spores, (13–)16–25(–30) µm long, subhyaline to pale yellowish-brown; wall 1.5–4 µm thick, smooth.

On *Setaria lachnea* (Nees) Kunth (*S. argentina* Herrm., *S. leiantha* Hack.), and *S. faberi* Herrm.; N. & S. America (USA, Argentina).

Key to the *Conidiosporomyces* and *Tilletia* species of *Setaria*

1. Conidia present between the spores. Sori thick, sack-like, opened ....
 .... 2 (*Conidiosporomyces*)
– Conidia absent between the spores. Sori not so .... 4 (*Tilletia*)
2. Spore mass grey to pale chestnut-brown. Immature spores and
 conidia between the spores abundant 3
– Spore mass reddish-brown. Immature spores and conidia
 relatively few. Spores coarsely conical-echinulate .... *C. verruculosus*
3. Spores 13–17 µm long, predominantly verrucose or verrucose-
 echinulate, warts 1–2 µm high, often flattened.................................. *C. ayresii*
– Spores (14.5–)16–20(–23) µm long, predominantly filamentously
 verrucose, warts 1.5–3(–5) µm high....................................... *C. echinospermus*
4. Sori pubescent 5
– Sori smooth to rough, not pubescent 6
5. Spores reticulate, 18–23 µm long.. *T. setaricola*
– Spores finely, densely verrucose, 13–18 µm long .... *T. zundelii*
6. Spores 22.5–33 µm long, with 1.5–2.5 µm high warts 7
– Spores smaller, with c. 1 µm high warts 8
7. Spores 24–33 µm long, warts coarse, subconical, 8–13 per spore
 diameter.. *T. setariae*
– Spores 22.5–28 µm long, warts delicate, acute, 11–17 per spore
 diameter... *T. setariae-viridis*
8. Spores 16–24 µm long, warts delicate. Sterile cells 16–26 µm long,
 wall 2–4.5 µm thick... *T. setariae-palmifoliae*
– Spores 13–19 µm long, warts coarse. Sterile cells 10–22 µm long,
 wall 1–1.5 µm thick... *T. thirumalachari*



Figs. 38–41. *Tilletia setariae-viridis* Vánky on *Setaria viridis* (L.) Beauv. (paratype). Fig. 38. A mature sorus and a healthy spikelet. Bar = 2 mm. Figs. 39, 40. Spores and sterile cells in LM and in SEM. Bars = 10 µm. Fig. 41. Germinating spore (on water agar, at room temp., in 5 days, of 4 months old spores). Bar = 10 µm.

NEW COMBINATIONS, SYNONYMS

Ustilentyloma oreochloae (Durrieu) Vánky, **comb. nov.**

Basionym: *Entyloma oreochloae* Durrieu, Bull. Soc. Mycol. France 79:130, 1963. — Type on *Oreochloa disticha* (Wulfen) Link, France, Pyrénées Orientales Dépt., Massif du Canigou Mt., Pic des Trois-Vents, 2700 m, 3.VIII.1961, G. Durrieu, TLA 1825!

Sori in the upper surface of rolled-up leaves as inconspicuous, subepidermal pustules, light yellowish-brown, 0.25–0.5 mm in diameter. *Spores* inconspicuous, crowded, subglobose, ellipsoidal or irregularly angular by mutual pressure, 6.5–9 x 7–10.5 µm, subhyaline to pale yellow; wall thin (c. 0.5 µm), smooth.

On Gramineae: *Oreochloa disticha* (Wulfen) Link (*Sesleria disticha* (Wulfen) Pers.); S-W. Europe (Mts. of Pyrenees).

Although the spore germination of this fungus is not known, I have no doubt that its place is not in the genus *Entyloma* but in the genus *Ustilentyloma*. Between the true *Entyloma* species (c. 165) and those of *Ustilentyloma* (4) there are important differences, i.a., in spore germination, ultrastructure and molecular biology, reflected in the new system of the smut fungi (comp. Bauer et al., 1997, Vánky, 1999a). In addition, the host plants of species of *Entyloma* are dicotyledonous, those of *Ustilentyloma* the monocotyledonous Gramineae.

Key to the species of *Ustilentyloma*

1. Spore wall thick (1.5–3 µm). On several genera of Gramineae ....*U. brefeldii*
– Spore wall thin (0.5–1 µm)..2
2. Spores 7–10.5 µm long. On *Oreochloa*...................................... *U. oreochloae*
– Spores larger. Not on *Oreochloa*. 3
3. Spores 8.5–15.5(–17) µm long. On *Glyceria*. .... *U. fluitans*
– Spores 11.5–19(–21) µm long. On *Pleuropogon*.................. *U. pleuropogonis*

Study of the type of *Sphacelotheca chrysopogonicola* Mundk. & Thirum. revealed characters of a *Macalpinomyces* (comp. Vánky, 1996:115-126, 1997a:128, 1998:112). Furthermore, it turned out that it is conspecific with the later described *Ustilago chrysopogonis* S. Ahmad (1956:2). Consequently, the name of this fungus and its synonyms are:

Macalpinomyces chrysopogonicola (Mundk. & Thirum.) Vánky, **comb. nov.**

Basionym: *Sphacelotheca chrysopogonicola* Mundk. & Thirum., in Thirumalachar & Mundkur, Mycol. Pap. 40:2, 1951. — Type on *Chrysopogon* sp., India, Mysore, Bangalore, Uttarahalli, 2.IX.1943, M. J. Thirumalachar, HCIO 10781!

Ustilago chrysopogonis S. Ahmad, 1956:2. — *Macalpinomyces chrysopogonis* (S. Ahmad) Vánky, 1997a:129. — Type on *Chrysopogon gryllus* (L.) Trin., Pakistan, Swat State, Kulali-Kalam, 19.VIII.1958, S. Ahmad. Isotype HUV 8999!

Sorosporium capillipedii Mishra, 1957:257. — *Endosporisorium capillipedii* (Mishra) Vánky, 1995:228. — Type on *Capillipedium parviflorum* (R. Br.) Stapf, India, Bihar, Hazaribagh, 10.X.1955, J. N. Mishra, BPI 179479!

For description and illustration see Vánky, 1995:227-230, figs. 16-20. (as *Endosporisorium capillipedii*).

EXCLUDED TAXON

TILLETIA ECHINOCHLOAE F. *FOLIICOLA* IS NOT A SMUT FUNGUS

Lavrov (1951:23) described *Tilletia echinochloae* in the seeds of *Echinochloa crus-galli* (L.) P. Beauv. from Russia. According to him, this smut is close to *T.*

pulcherrima Ellis & Galloway ex G. P. Clinton (lectotype on *Panicum virgatum* L., USA). The spores of this smut are verrucose or provided with truncate scales.

Schwarzman (1960:231) described *Tilletia echinochloae* Lavrov f. *foliicola* Schwarzman (type on *Echinochloa crus-galli*, Kazakhstan, AA!). According to Schwarzman, the sori form 1–5 mm long striae on the leaves. The spores are globose to subglobose, 18.7–26 µm long, first hyaline, later yellowish-brown, bright. In the diagnosis, Schwarzman repeating Lavrov wrote "episporio plus minusve conspecto hyalino praeditis, spinulosis vel costiformibus, spinulis et costis opacis vel hyalinis, acutis vel truncatis, areas polygonatis fere inconspicuis formantibus". The illustrations in Schwarzman, however, show spores with meshes, without trace of spines. The illustrated spores do not look like spores of a *Tilletia*. Repeated attempts to find spores in the type specimen, failed. I consider this taxon not to be a smut fungus.

LECTOTYPE

McAlpine (1910:169) describing *Cintractia distichlidis* (= *Ustilago distichlidis* (McAlpine) Ciferri) on *Distichlis maritima* Rafin, enumerated three collections without indicating the type. Of the three syntypes I am designating as a lectotype the one collected in Australia, Victoria, Port Phillip, Oct. 1891, coll. C. French jr., MEL 1055118!

ACKNOWLEDGEMENTS

I am grateful to Dr. S. Tóth (Gödöllő, Hungary) for providing the Latin descriptions, to Professor emeritus N. Lundqvist (Storvreta, Sweden) and Dr. E. McKenzie (Auckland, New Zealand) for reading the manuscript and serving as pre-submission reviewers. Many thanks to Dr. S. Ahmad (Lahore, Pakistan), Dr. J. Alcorn (Indooroopilli, Australia), Dr. J. David (Egham, UK), Prof. emeritus R. Durán (Pullman, USA), Dr. R. V. Gandhe (Poona, India), Dr. P. K. Latz and Dr. D. Albrecht (Alice Springs, Australia), Dr. M. Priest (Orange, Australia), and to Prof. M. S. Patil (Kolhapur, India) for isotypes or smutted plants. Thanks are also due to Dr. G. Zijlstra (Utrecht, Netherlands) for information regarding the correct spelling and systematic position of *Hydrocleys*, and to the Directors and Curators of the Herbaria AA, BP, BPI, BR, BRIP, DAR, GH, HBG, HCIO, HMAS, IMI, LE, LPS, MA, PDD, PREM and WSP for loan and/or exchange of specimens.

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MYCOTAXON

Volume LXXVIII, pp. 327-343 April-June 2001

A REASSESSMENT OF THE CERCOSPORA SPECIES DESCRIBED BY C. CHUPP: SPECIMENS DEPOSITED AT BPI, MARYLAND, U.S.A.

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Abstract: Cercosporoid specimens lodged at BPI herbarium, including 31 type specimens originally treated by Charles Chupp were examined in the present study. Nine of these taxa are redisposed to *Passalora*, *Pseudocercospora* or *Stenella*. *Mycosphaerella shoreae* is newly described as the teleomorph of *Stenella shoreae*, occurring on *Shorea talura* from India. *Pseudocercospora zanthoxylicola* is proposed as a new name for *Cercospora fagarae* Chidd., known on *Zanthoxylum budrunga*, also from India.

Key Words: *Mycosphaerella*, *Passalora*, *Pseudocercospora*, *Stenella*, systematics

Introduction

The most complete treatment of the genus *Cercospora* Fresen. was that of Chupp (1954). In his monograph, Chupp placed all taxa in *Cercospora*, and briefly noted whether conidia occurred singly or were catenulate, pigmented or hyaline, as well as the nature of the conidial scars. Subsequent to this monographic study Deighton treated many of these species (1967, 1974, 1976, 1979), and relocated several to more well-defined anamorph genera. The features distinguishing these genera were also accepted by others, which in turn led to the creation of more genera. These genera have been recognised in treatments of these fungi from numerous countries including Taiwan (Hsieh & Goh, 1990), China (Guo & Hsieh, 1995), South Africa (Crous & Braun, 1996) and Russia

(Braun & Melnik, 1997). New technology aiding the separation of these anamorph genera have been the use of Scanning Electron Microscopy to show differences in the type of conidial scar structure (David, 1993), as well as the employment of molecular techniques (Stewart *et al.*, 1999; Crous *et al.*, 1999, 2000). In cases where specific hosts have been studied intensively, numerous cercosporoid fungi have been recorded (i.e. Crous, 1998). Because several morphologically similar, but different species can occur on the same host in different countries, numerous literature reports of "well-known" cercosporoids are in fact of different, and frequently undescribed taxa. To resolve this issue, it is of the utmost importance that the taxa treated by Chupp (1954) are re-examined using the concepts presently applied to this group. In this paper we present a treatment of the *Cercospora* type specimens treated by Chupp that are lodged at BPI in Maryland, U.S.A.

Treatment of species

1. *Cercospora achyranthina* Thirum. & Chupp, *Mycologia* **40,** 352 (1948).

Host(s) & Dist.: *Achyranthes* spp. (Amaranthaceae); Burma, India, Pakistan, Philippines, Zimbabwe, Sudan, Tanzania.

Specimen examined: India, Bangalore, living leaves of *Achyranthes aspera* L., M.J. Thirumalachar, 20 Aug. 1944, BPI 432384 (holotype).

Leaf spots small, circular light brown. Conidiophores unbranched and arranged in brown fascicles. Conidia long, hyaline, acicular, multiseptate, with truncate to slightly obconically truncate bases and subobtuse apices, proving that this species forms part of the *Cercospora apii* Fresen. complex.

2. *Cercospora cytisi* Chupp, A monograph of the fungus genus *Cercospora*, p. 300 (1954).

Host(s) & Dist.: *Cytisus* spp. (Leguminosae); U.S.A.

Specimen examined: U.S.A., Kansas, Manhattan, living leaves of *Cytisus capitatus* Scop., Kellerman & Swingle, 4 Sept. 1889, BPI 435451 (holotype).

This species forms part of the *Cercospora apii* complex, being characterised by long, multiseptate, acicular conidia with truncate bases and acute to subobtuse apices.

3. *Cercospora exochordae* Chupp & J.A. Stev., A monograph of the fungus genus *Cercospora*, p. 476 (1954).

≡ *Pseudocercospora exochordae* (Chupp & J.A. Stev.) Deighton, *Trans. Br. Mycol. Soc.* **88,** 389 (1987).

Host(s) & Dist.: *Exochorda* spp. (Rosaceae); U.S.A.

Specimen examined: U.S.A., Alabama, Tuskegee, living leaves of *Exochorda* racemosa (Lindl.) Rehder (= *E. grandiflora* Lindl.), G.W. Carver, 1 Sept. 1935, BPI 436248 (holotype).

Deighton disposed this species to *Pseudocercospora* Speg. A re-examination of the type clearly shows, however, that this species is in fact a true representative of *Cercospora*, which has hyaline, multiseptate, acicular conidia, and long unbranched, brown conidiophores. Furthermore, these features also demonstrate this species to be indistinguishable from others in the *Cercospora apii* complex.

4. ***Cercospora lithospermi*** Chupp & H.C. Greene, *Am. Midland Naturalist* **41,** 724 (1949).

Host(s) & Dist.: *Lithospermum* spp. (Boraginaceae); U.S.A.

Specimen examined: U.S.A., Wisconsin, Madison, living leaves of *Lithospermum carolinense* (J.F. Gmelin) MacMill, H.C. Greene, 26 Sept. 1945, BPI 437832 (holotype).

Chupp (1954) described conidia as being acicular to obclavate. A re-examination of the type found them to be more obclavate, being widest at the first basal septum, multiseptate, with long obconically truncate bases and subobtuse apices. Although Chupp (1954) cites conidia to be 25–200 × 2–4 μm, only conidia 30–90 × 3–5 μm were observed. Conidiophores were light brown, densely fasciculate, 15–50 × 3.5–6 μm. Based on the conidium and conidiophore morphology, therefore, this species is clearly distinct from the *Cercospora apii* complex.

5. ***Cercospora madisonensis*** Chupp & H.C. Greene, *Trans. Wis. Acad. Sci. Arts Lett.* **35,** 132 (1944).

Host(s) & Dist.: *Stenandrium* (= *Gerardia*) spp. (Acanthaceae); U.S.A.

Specimen examined: U.S.A., Wisconsin, Madison, living leaves of *Gerardia grandiflora* Benth., H.C. Greene, 14 Sept. 1942, BPI 438018 (holotype).

This species is associated with small, circular, white leaf spots. Morphologically it is characterised by long, fasciculate, unbranched, brown conidophores that give rise to hyaline, acicular conidia with truncate bases and subobtuse apices, 20–100 × 2–4 μm. This species forms part of the *Cercospora apii* complex.

6. ***Cercospora partheniphila*** Chupp & H.C. Greene, *Am. Midland Naturalist* **34,** 269 (1945).

Host(s) & Dist.: *Parthenium* spp. (Compositae); Dominican Republic, U.S.A.

Specimen examined: U.S.A., Wisconsin, Madison, living leaves of *Parthenium integrifolium* L., H.C. Greene No. 882, 20 Sept. 1944, BPI 439253 (holotype).

Morphologically this collection resembles other species in the *Cercospora apii* complex.

7. ***Cercospora peregrina*** Chupp, A monograph of the fungus genus *Cercospora*, p. 49 (1954).

Host(s) & Dist.: *Tabernaemontana* spp. (Apocynaceae); India, Mexico, U.S.A.

Specimen examined: Unknown, probably Mexico, intercepted at Texas, Brownsville U.S.A., living leaves of *Tabernaemontana divaricata* (L.) R.Br. (= *T. coronaria* (Jacq.) Willd.), Hansel, 1 Nov. 1944, BPI 439428 (holotype).

This species is indistinguishable from others in the *Cercospora apii* complex.

8. *Cercospora petila* Thirum. & Chupp, *Mycologia* **40,** 359 (1948).
Host(s) & Dist.: *Euphorbia* spp. (Euphorbiaceae); India.

Specimen examined: India, Bangalore, living leaves of *Euphorbia pulcherrima* Willd. ex Klotzsch, M.J. Thirumalachar, 11 Nov. 1945, BPI 439608 (holotype).

Conidia of this species are hyaline to subhyaline, suggesting that this taxon is intermediate between *Cercospora* and *Passalora* Fr. However, the conidial scars are predominantly thickened, uniformly darkened and refractive, except for the central pore, suggesting that it is a true species of *Cercospora*, as the conidial scar thickening is less prominent in *Passalora*. Furthermore, conidia are narrowly obclavate with subtruncate bases and obtuse apices, suggesting this species to be distinct from the *C. apii* complex. Hsieh & Goh (1990) considered the possibility that it could be synonymous with *Pseudocercospora petila* Goh & W.H. Hsieh. However, the two taxa are clearly distinct.

9. *Cercospora petiveriae* Chupp, A monograph of the fungus genus *Cercospora*, p. 437 (1954).
Host(s) & Dist.: *Petiveria* spp. (Phytolaccaceae); Puerto Rico, South America.

Specimen examined: Mona Island, base of cliff at Sardinera, living leaves of *Petiveria alliacea* Linn., C.E. Chardon & J.I. Otera No. 152, 21 Jul. 1944, BPI 439609 (holotype).

This species is representative of the *C. apii* complex.

10. *Cercospora secalis* Chupp, A monograph of the fungus genus *Cercospora*, p. 252 (1954).
Host(s) & Dist.: *Secale* spp. (Gramineae); U.S.A.

Specimen examined: U.S.A., Virginia, Fredericksburg, living leaves of *Secale cereale* L., C.L. Lefebvre & A.G. Johnson, 9 Jun. 1947, BPI 441070 (holotype).

This species belongs in the *C. apii* complex.

11. *Cercospora stanleyae* (Ellis & E.B. Barthol.) Chupp, A monograph of the fungus genus *Cercospora*, p. 183 (1954) (*comb. illegit.*).
≡ *Cercospora nasturtii* var. *stanleyae* Ellis & E.B. Barthol., unknown *fide* Chupp (1954, p. 183).
Host(s) & Dist.: *Stanleya* spp. (Cruciferae); U.S.A.

Specimen examined: U.S.A., Kansas, Rockport, Rooks Co., living leaves of *Stanleya pinnatifida* Nutt., E.B. Bartholomew, 24 Aug. 1895, BPI 441636 (holotype).

Chupp (1954) proposed an invalid new combination, based on an unpublished basionym. However, this species is part of the *C. apii* complex, and it is therefore not necessary to validate the name, as it is probably synonymous with the latter.

12. *Cercospora stevensonii* Chupp, A monograph of the fungus genus *Cercospora*, p. 231 (1954).

Host(s) & Dist.: *Codiaeum* spp. (Euphorbiaceae); U.S.A.

Specimen examined: U.S.A., Texas, Brownsville, living leaves of *Codiaeum variegatuum* (L.) Blume, C.G. Anderson No. 49910, 20 Jan. 1942, BPI 441656 (holotype).

This species is a true *Cercospora*, and distinct from the *C. apii* complex based on its bluntly acicular conidia that are widest at the first basal septum, and have more obconically truncate bases.

13. *Cercospora wisconsinensis* Chupp & H.C. Greene, *Trans. Wis. Acad. Sci. Arts Lett.* **36,** 267 (1946).

Host(s) & Dist.: *Prenanthes* spp. (Compositae); U.S.A.

Specimen examined: U.S.A., Wisconsin, Madison, living leaves of *Prenanthes alba* L., H.C. Greene, 9 Sept. 1943, BPI 442537.

This species belongs to the *C. apii* complex.

14. *Denticularia tertia* (Chupp & H.C. Greene) Deighton, *Trans. Br. Mycol. Soc.* **61,** 115 (1973).

≡ *Cercospora tertia* Chupp & H.C. Greene, *Am. Midland Naturalist.* **34,** 269 (1945).

Host(s) & Dist.: *Aster* spp. (Compositae); U.S.A.

Specimen examined: U.S.A., Wisconsin, Madison, living leaves of *Aster ptarmicoides* (Nees) Torr. & A. Gray, H.C. Greene, 9 Aug. 1944, BPI 441875 (holotype).

15. *Passalora ambrosiae* (Chupp) Crous & U. Braun, comb. nov. Fig. 1

≡ *Cercospora ambrosiae* Chupp, *J. Dep. Agric. P. Rico* **14,** 282 (1930).

Leaf spots amphigenous, irregular to elongate, 0.5–5 mm diam., grey, occurring with dark brown spots caused by a *Septoria* sp. *Mycelium* internal, composed of smooth, branched, hyaline hyphae, 2–3 µm diam. *Caespituli* hypophyllous, brown, up to 60 µm wide and 130 µm high. *Conidiophores* aggregated in fairly dense fascicles, arising from the upper cells of a brown stroma up to 60 µm wide and 35 µm high; conidiophores light brown, finely verruculose, subcylindrical, 0–4-septate, light brown, straight to geniculate-sinuous, unbranched, 30–100 × 3–6 µm. *Conidiogenous cells* terminal, unbranched, light brown, finely verruculose to smooth, tapering to flat-tipped apical loci, with darkened, thickened, refractive conidial scars, proliferating sympodially, 12–30 × 5–6 µm. *Conidia* solitary, olivaceous, smooth, obclavate-cylindrical, apex obtuse, base obconically truncate, straight to mildly curved, 1–5-

septate, 28–95 × 6–10 µm; hila thickened, darkened throughout, refractive.

Host(s) & Dist.: *Ambrosia* spp. (Asteraceae); Colombia, Dominican Republic, Puerto Rico, Venezuela.

Specimen examined: Colombia, Ferrocarril de Girardot, Dept. Cundinamarca, living leaves of *Ambrosia peruviana* Willd., C.E. Chardon & J.A.B. Nolla No. 580, 21 Jun. 1929, BPI 432585 (holotype).

Conidia are olivaceous, obclavate-cylindrical, 1–5-septate with thickened, darkened scars. These features indicate that this species is best placed in *Passalora*.

16. *Passalora fagarina* (Chupp) Crous & U. Braun, comb. nov. Fig. 2

≡ *Cercospora fagarina* Chupp, A monograph of the fungus genus *Cercospora*, p. 504 (1954).

≡ *Cercospora fagarae* Hansf. (*fagariae*), *Proc. Linn. Soc. London* **158,** 50 (1947) (homonym).

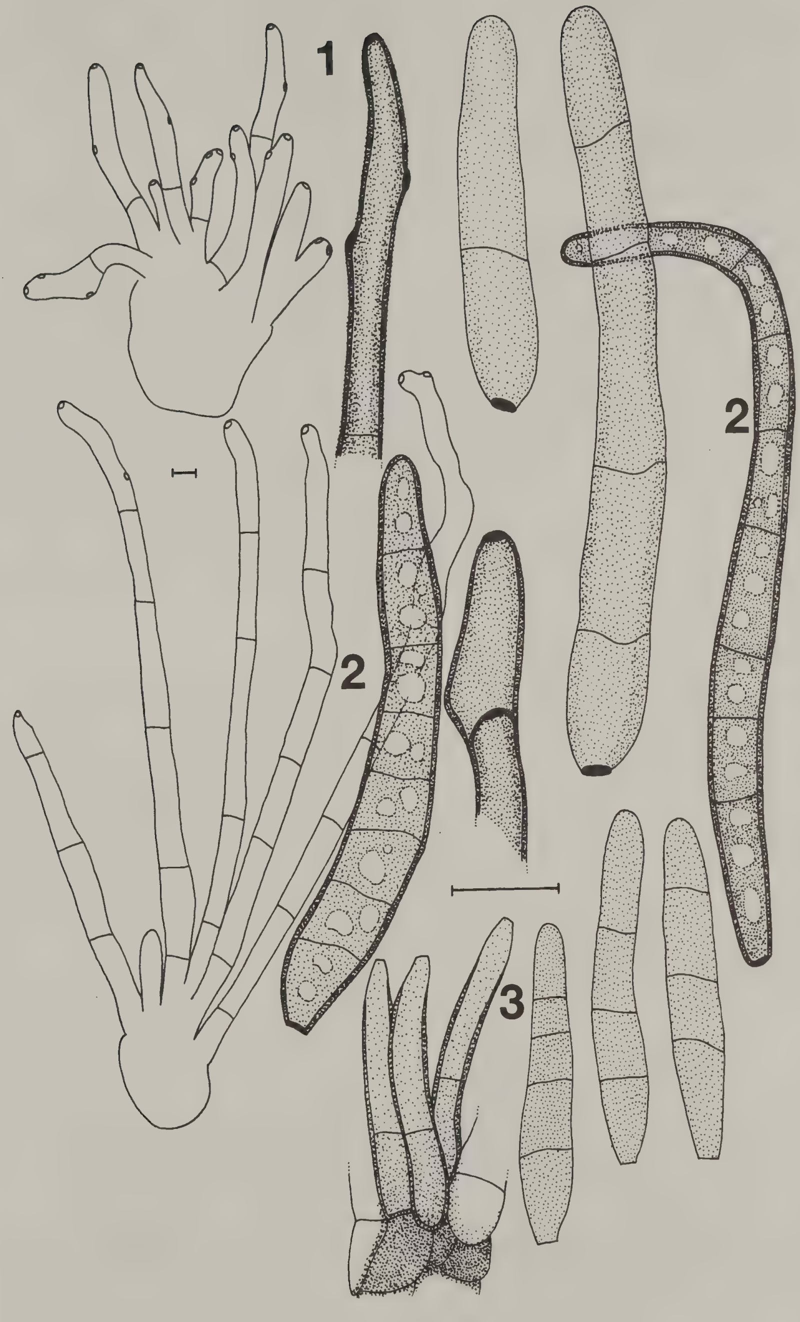
Leaf spots amphigenous, irregular to angular, up to 4 mm diam., grey to light brown. *Mycelium* internal, composed of smooth, branched, hyaline hyphae, 2–3 µm diam. *Caespituli* amphigenous, medium brown, up to 100 µm wide and 340 µm high. *Conidiophores* aggregated in loose fascicles, arising from the upper cells of a weakly developed brown stroma; conidiophores medium brown, finely verruculose, subcylindrical, multiseptate, medium brown, straight to geniculate-sinuous, unbranched, up to 300 µm long and 7 µm wide. *Conidiogenous cells* terminal, unbranched, light to medium brown, smooth to finely verruculose, tapering to rounded apices, with darkened, thickened, refractive conidial scars, proliferating sympodially, 20–60 × 5–7 µm. *Conidia* solitary, light to medium brown, finely verruculose, obclavate, apex obtuse, base obconically truncate, straight to curved, 4–13-septate, 45–100 × 7–10 µm; hila thickened, darkened throughout, refractive.

Host(s) & Dist.: *Zanthoxylum* spp. (Rutaceae); Uganda.

Specimen examined: Uganda, Entebbe Road, living leaves of *Zanthoxylum nitens* Hiern (= *Fagara angolensis*), C.G. Hansford No. 3569, 1944, BPI 409810 (holotype).

Based on the structure of the conidial scars as well as pigmented conidia, the present species clearly belongs in *Passalora*. Chupp validated the homonym *Cercospora fagarae* Hansf. by changing the species epithet. However, he incorrectly cited it as a new combination, instead of a new name. In placing this species in *Passalora*, the author of the basionym is therefore Chupp, and not Hansf. as indicated by Chupp (1954).

Figs 1–3. Conidiophores and conidia of *Passalora ambrosiae* (Fig. 1), *Passalora fagarina* (Fig. 2) and *Pseudocercospora zanthoxylicola* (Fig. 3). Bars = 10 µm.



Cercospora fagarae Chidd. (1959) is a later homonym of *Cercospora fagarae* W. Yamam. (1934) and *Cercospora fagarae* Hansf. (1947). Other than being a species of *Pseudocercospora*, a new species epithet is also proposed to validate this species: ***Pseudocercospora zanthoxylicola*** Crous & U. Braun, nom. nov. (Fig. 3) (≡ *Cercospora fagarae* Chidd., *Sydowia* **13,** 160. 1959, homomym).

Leaf spots amphigenous, subcircular to irregular, 4–20 mm diam., medium brown to dark brown, with indistinct borders. *Mycelium* internal, composed of smooth, branched, hyaline to pale brown hyphae, 3–4 µm diam. *Caespituli* hypophyllous, black, up to 130 µm wide and 80 µm high. *Conidiophores* aggregated in dense fascicles, arising from the upper cells of a brown stroma up to 80 µm wide and 70 µm high; conidiophores light brown, smooth, subcylindrical, 0–2-septate, straight to mildly curved, predominantly unbranched, rarely branched above, 20–50 × 3–4 µm. *Conidiogenous cells* terminal, unbranched, pale brown, smooth, tapering to flat-tipped apices, conidial scars inconspicuous, proliferating sympodially, 15–25 × 3–4 µm. *Conidia* solitary, light to medium brown, finely verruculose, obclavate-subcylindrical, apex obtuse, base obconically truncate, straight to slightly curved, 1–5-septate, 25–40 × 5–6 µm; hila unthickened, not darkened.

Host(s) & Dist.: *Zanthoxylum* spp. (Rutaceae); India.

Specimen examined: India, Bombay State, living leaves of *Zanthoxylum budrunga* DC (= *Fagara budrunga*), P.P. Chiddarwar, 5 Mar. 1956, BPI 436259 (holotype).

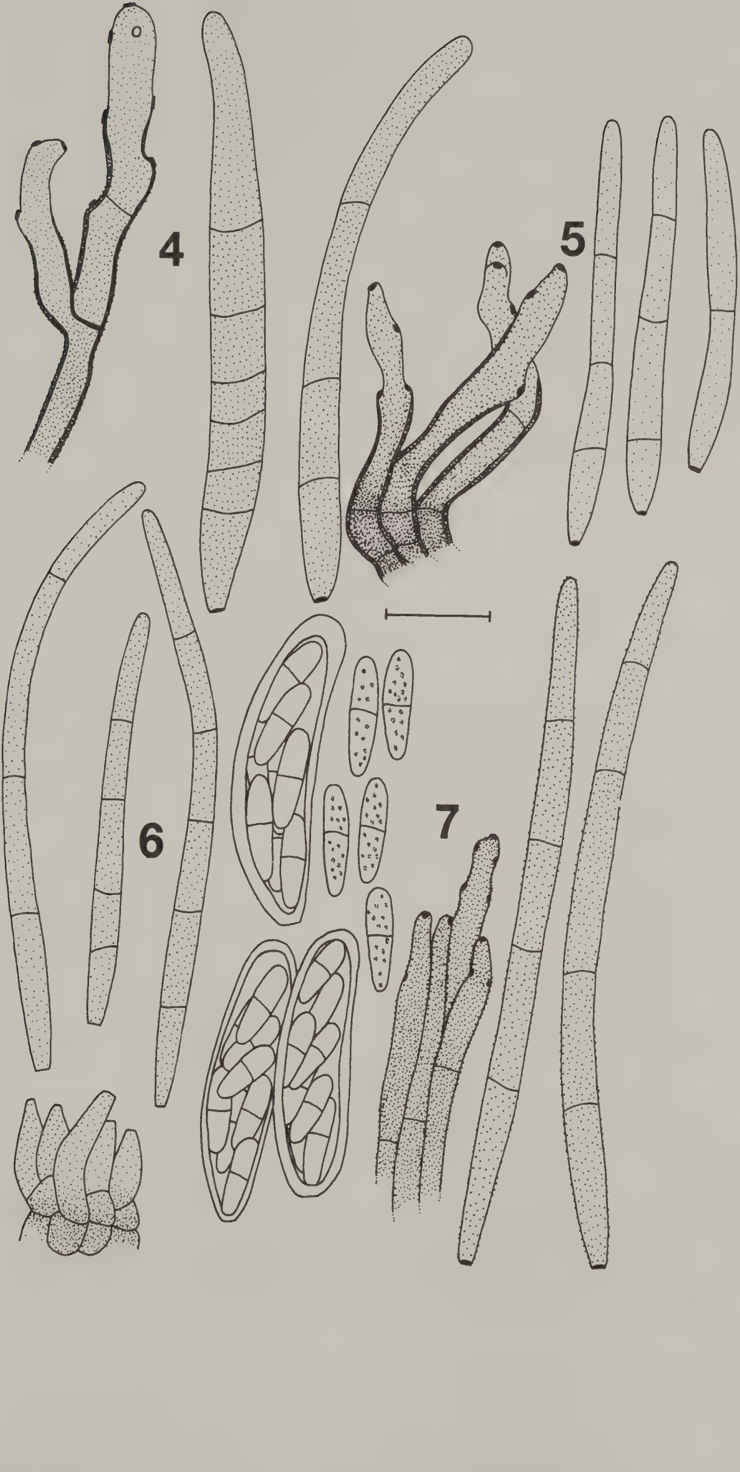
Pseudocercospora zanthoxylicola is distinct from *P. fagarae* (W. Yamam.) Deighton (on *Zanthoxylum* from Taiwan), which has longer and narrower conidia, 20–105 × 3–5.5 µm, with up to 11 septa (Chupp, 1954). Furthermore, it is also distinct from *P. xanthoxyli* (Cooke) Y.L. Guo & X.J. Liu (= *P. fagaricola* Goh & W.H. Hsieh) which has epiphyllous fruiting structures, and narrower conidia, 20–65 × 2–4 µm with up to 10 septa (Hsieh & Goh, 1990).

17. *Passalora lettsomiae* (Thirum. & Chupp) Crous & U. Braun, comb. nov. Fig. 4

≡ *Cercospora lettsomiae* Thirum. & Chupp, *Mycologia* **40,** 356 (1948).

Leaf spots amphigenous, angular, up to 2 mm diam., dark brown to black. *Mycelium* internal, composed of smooth, branched, hyaline hyphae, 2–3 µm diam. *Caespituli* predominantly hypophyllous, brown, up to 50 µm

Figs 4–7. Conidiophores and conidia of *Passalora lettsomiae* (Fig. 4), *Passalora panacis* (Fig. 5), and *Pseudocercospora pistaciae* (Fig. 6). Asci, ascospores, conidiophores and conidia of *Mycosphaerella shoreae* and its anamorph, *Stenella shoreae* (Fig. 7). Bar = 10 µm.



wide and 40 µm high. *Conidiophores* aggregated in loose fascicles, arising from the upper cells of a weakly developed stroma, consisting of a few pale brown cells; conidiophores light brown, finely verruculose, subcylindrical, 1–4-septate, straight to geniculate-sinuous, unbranched or branched above, 30–50 × 4–5 µm. *Conidiogenous cells* terminal, light brown, finely verruculose, tapering to rounded apices, with darkened, thickened, refractive conidial scars, proliferating sympodially, 10–25 × 4–5 µm. *Conidia* solitary, light brown, finely verruculose, obclavate, apex obtuse, base obconically truncate, straight to curved, 1–6-septate, 20–75 × 3–4.5 µm; hila thickened, darkened throughout, refractive.

Host(s) & Dist.: *Argyreia* (= *Lettsomia*) spp. (Convolvulaceae); India.

Specimen examined: India, Bangalore, living leaves of *Lettsomia elliptica* Wright, M.J. Thirumalachar, 20 Dec. 1945, BPI 437663 (holotype).

The conidial shape, septation, and pigmentation place this species in *Passalora*.

18. *Passalora panacis* (Thirum. & Chupp) Crous & U. Braun, comb. nov. Fig. 5

≡ *Cercospora panacis* Thirumalachar & Chupp, *Mycologia* **40,** 358 (1948).

≡ *Pseudocercospora panacis* (Thirum. & Chupp) Y.L. Guo & X.J. Liu, *Acta Mycol. Sinica* **11,** 297 (1992).

Leaf spots amphigenous, circular, up to 20 mm diam., medium brown with a dark brown border. *Mycelium* internal, composed of smooth, branched, hyaline hyphae, 3–4 µm diam. *Caespituli* predominantly hypophyllous, brown, up to 80 µm wide. *Conidiophores* aggregated in dense fascicles, arising from the upper cells of a brown stroma up to 50 µm wide and 30 µm high; conidiophores light brown, smooth, subcylindrical, 0–3-septate, straight to geniculate-sinuous, unbranched or branched above, 20–40 × 3.5–6 µm. *Conidiogenous cells* terminal, light brown, smooth, tapering to flat-tipped apices, with darkened, thickened, refractive conidial scars, proliferating sympodially, 10–20 × 3–4 µm. *Conidia* solitary, olivaceous, smooth, obclavate, apex subobtuse, base obconically truncate, straight to mildly curved, 1–5-septate, 16–70 × 2.5–4 µm; hila thickened, darkened throughout, slightly refractive.

Host(s) & Dist.: *Kalopanax* spp., *Panax* spp. (Araliaceae); Cambodia, India.

Specimen examined: India, Bangalore, living leaves of *Panax fruticosum* Linn., M.J. Thirumalachar, 5 Aug. 1944, BPI 439221 (holotype).

The conidial scars are somewhat thickened and darkened and the conidia are pigmented, so that this species has to be transferred to *Passalora*.

19. *Passalora querci* (Chupp) Crous & U. Braun, comb. nov. Fig. 8

≡ *Cercospora querci* Chupp, A monograph of the fungus genus *Cercospora*, p. 233 (1954).

Leaf spots amphigenous, irregular to circular, 1–3 mm diam., pale brown, coalescing with age. *Mycelium* internal and external, light brown, consisting of branched, smooth hyphae, 3–4 µm. *Conidiophores* amphigenous, rarely arranged in weakly developed brown fascicles, predominantly arising singly from superficial mycelium, climbing leaf hairs; light brown, non- to multiseptate, subcylindrical, straight to variously curved, branched or not, 10–100 × 3–4 µm. *Conidiogenous cells* terminal, unbranched, light brown, smooth, tapering to flat-tipped apices, conidial scars darkened, refractive and thickened, proliferating sympodially, 10–25 × 3–4 µm. Conidia solitary, olivaceous, smooth, thick-walled, narrowly obclavate, apex subobtuse, base long obconically truncate, straight to slightly curved, multiseptate, 40–250 × 2–4.5 µm; hila thickened, and darkened.

Host(s) & Dist.: *Quercus* spp. (Fagaceae); U.S.A.

Specimen examined: U.S.A., Louisiana, Kentwood, living leaves of *Quercus bicolor* Willd., unknown collector, 10 Jul. 1936, BPI 440181 (holotype).

The combination of conspicuous conidial scars, pigmented conidia, and superficial secondary mycelium refers the present species to *Mycovellosiella* Rangel. However, comprehensive molecular examinations of *Mycosphaerella* spp. with cercosporoid anamorphs as well as morphological considerations revealed that *Mycovellosiella* has to be reduced to synonymy with *Passalora* (Crous *et al.*, 2000).

20. *Pseudocercospora bangalorensis* (Thirum. & Chupp) Deighton, *Mycol. Pap.* **140,** 140 (1976).

≡ *Cercospora bangalorensis* Thirum. & Chupp, *Mycologia* **40,** 353 (1948).

Host(s) & Dist.: *Aristolochia* spp. (Aristolochiaceae); India.

Specimen examined: India, Bangalore, living leaves of *Aristolochia indica* L., M.J. Thirumalachar, 20 Aug. 1944, BPI 433248 (holotype).

21. *Pseudocercospora broussonetiae* (Chupp & Linder) X.J Liu & Y.L. Guo, *Mycosystema* **2,** 229 (1989).

≡ *Cercospora broussonetiae* Chupp & Linder, *Mycologia* **29,** 27 (1937).

Host(s) & Dist.: *Broussonetia* spp. (Moraceae); China, Japan, New Caledonia, U.S.A.

Specimen examined: China, Kwangsi Prov., Yung Hsien, living leaves of *Broussonetia* sp., S.Y. Cheo No. 2900, 17 Oct. 1933, BPI 433862 (holotype).

22. *Pseudocercospora jamaicensis* (Chupp) Deighton, *Mycol. Pap.* **140,** 146 (1976).

≡ *Cercospora jamaicensis* Chupp, A monograph of the fungus genus *Cercospora*, p. 542 (1954).

Host(s) & Dist.: *Brugmansia* spp. (Solanaceae); Costa Rica, India, Jamaica.

Specimen examined: Jamaica, Shaw Park Hotel, above Ocho Rios, living leaves of *Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Bercht. & J. Presl) (= *Datura suaveolens* Humb. & Bonpl. ex Willd., C.E. Chardon No. 39, 8 Apr. 1945, BPI 437481 (holotype).

23. *Pseudocercospora leguminum* (Chupp & Linder) Deighton, *Mycol. Pap.* **140,** 55 (1976).

≡ *Cercospora leguminum* Chupp & Linder, *Mycologia* **29,** 30 (1937).

Host(s) & Dist.: *Crotalaria* spp., *Desmodium* spp. (Leguminosae); China.

Specimen examined: China, Kwangsi Prov., Ling Yuin Hsien, living leaves of *Crotalaria* sp., S.Y. Cheo No. 2873, 1 Oct. 1933, BPI 437628 (holotype).

24. *Pseudocercospora mysorensis* (Thirum. & Chupp) Deighton, *Mycol. Pap.* **140,** 148 (1976).

≡ *Cercospora mysorensis* Thirum. & Chupp, *Mycologia* **40,** 357 (1948).

= *Cercospora pouzolziae* Sawada, *Taiwan Agric. Res. Inst. Rep.* **87,** 86 (1944) (*nom. inval.*).

Host(s) & Dist.: *Boehmeria* spp., *Pouzolzia* spp. (Urticaceae); China, India, Taiwan.

Specimen examined: India, Mysore, Nandi Hills, living leaves of *Pouzolzia bennettiana* Wright, M.J. Thirumalachar, 17 Dec. 1945, BPI 438719 (holotype).

25. *Pseudocercospora paramignyae* (Thirum. & Chupp) Y.L. Guo, *Mycosystema* **6,** 103 (1993).

≡ *Cercospora paramignyae* Thirum. & Chupp, *Mycologia* **40,** 358 (1948).

Host(s) & Dist.: *Euodia* (= *Evodia*) spp., *Paramignya* spp. (Rutaceae); China, India.

Specimen examined: India, Mysore, Balchonnur, living leaves of *Paramignya* sp., M.J. Thirumalachar, 29 Apr. 1945, BPI 439236 (holotype).

26. *Pseudocercospora pistaciae* (Chupp) Crous & U. Braun, comb. nov.

Fig. 6

≡ *Cercospora pistaciae* Chupp, A monograph of the fungus genus *Cercospora,* p. 41 (1954).

= *Cercospora pistaciae* ("*pistaceae*") Sawada, *Spec. Publ. 8, Coll. Agric. Nat. Taiwan Univ. Descriptive Catalogue of Taiwan (Formosan) Fungi* **11,** 224 (1959) (*nom. nud.*).

Leaf spots amphigenous, irregular, 0.5–3 mm diam., grey-brown to brown, surrounded by a dark brown border, coalescing with age. *Mycelium* internal and external, composed of smooth, branched, light brown hyphae, 3–4 µm diam. *Caespituli* amphigenous, brown, up to 70 µm wide. *Conidiophores* arising singly from superficial mycelium, or aggregated in dense fascicles, arising from the upper cells of a brown stroma, up to 60 µm wide; conidiophores light brown, smooth, subcylindrical, reduced to conidiogenous cells, straight to slightly curved, unbranched, 5–15 × 2–3.5 µm, conidial scars inconspicuous. *Conidia* solitary, olivaceous, smooth, subcylindrical to narrowly obclavate, apex subobtuse, base narrowly obconically truncate, straight to curved, 3–5-septate, 20–60 × 2–3 µm; hila unthickened, not darkened.

Host(s) & Dist.: *Pistacia* spp. (Anacardiaceae); Taiwan, U.S.A.

Specimen examined: U.S.A., Texas, San Antonio, living leaves of *Pistacia vera* L., G.T. Radliffe, Sept. 1931, BPI 439746 (holotype).

Based on inconspicuous conidial scars, this species clearly belongs in *Pseudocercospora*.

27. *Pseudocercospora waltheriae* (Thirum. & Chupp) Deighton, *Mycol. Pap*. **140,** 155 (1976).

≡ *Cercospora waltheriae* Thirum. & Chupp, *Mycologia* **40,** 361 (1948).

Host(s) & Dist.: *Waltheria* spp. (Sterculiaceae); India.

Specimen examined: India, Bangalore, Yashavantapur, living leaves of *Waltheria indica* L., M.J. Thirumalachar, 2 Sept. 1945, BPI 442533 (holotype).

28. *Pseudocercospora wrightiae* (Thirum. & Chupp) Deighton, *Mycol. Pap*. **140,** 156 (1976).

≡ *Cercospora wrightiae* Thirum. & Chupp, *Mycologia* **40,** 362 (1948).

Host(s) & Dist.: *Wrightia* spp. (Apocynaceae); China, India.

Specimen examined: India, Bangalore, living leaves of *Wrightia tinctoria* (Roxb.) R. Br., M.J. Thirumalachar, 26 Dec. 1945, BPI 442539 (holotype).

29. *Mycosphaerella shoreae* Crous & U. Braun, sp. nov. Fig. 7

Anamorph: ***Stenella shoreae*** (Thirum. & Chupp) Crous & U. Braun, comb. nov.

≡ *Cercospora shoreae* Thirum. & Chupp, *Mycologia* **40,** 360 (1948).

≡ *Pseudocercospora shoreae* (Thirum. & Chupp) Deighton, *Mycol. Pap*. **140,** 153 (1976).

Pseudothecia epiphylla, nigra, subepidermalia, globosa, usque ad 90 µm lata. Asci fasciculati, bitunicati, obovoidei ad ellipsoidei, recti vel curvati, 20–30 × 8–10 µm. Ascosporae bi- ad triseriatae, hyalinae, guttulatae, tenuitunicatae, rectae, fusoideo-ellipsoideae, apice obtusae, latissimae in medio cellulae apicalis, in medio 1-septatae, 8–13 × 2.5–3 µm.

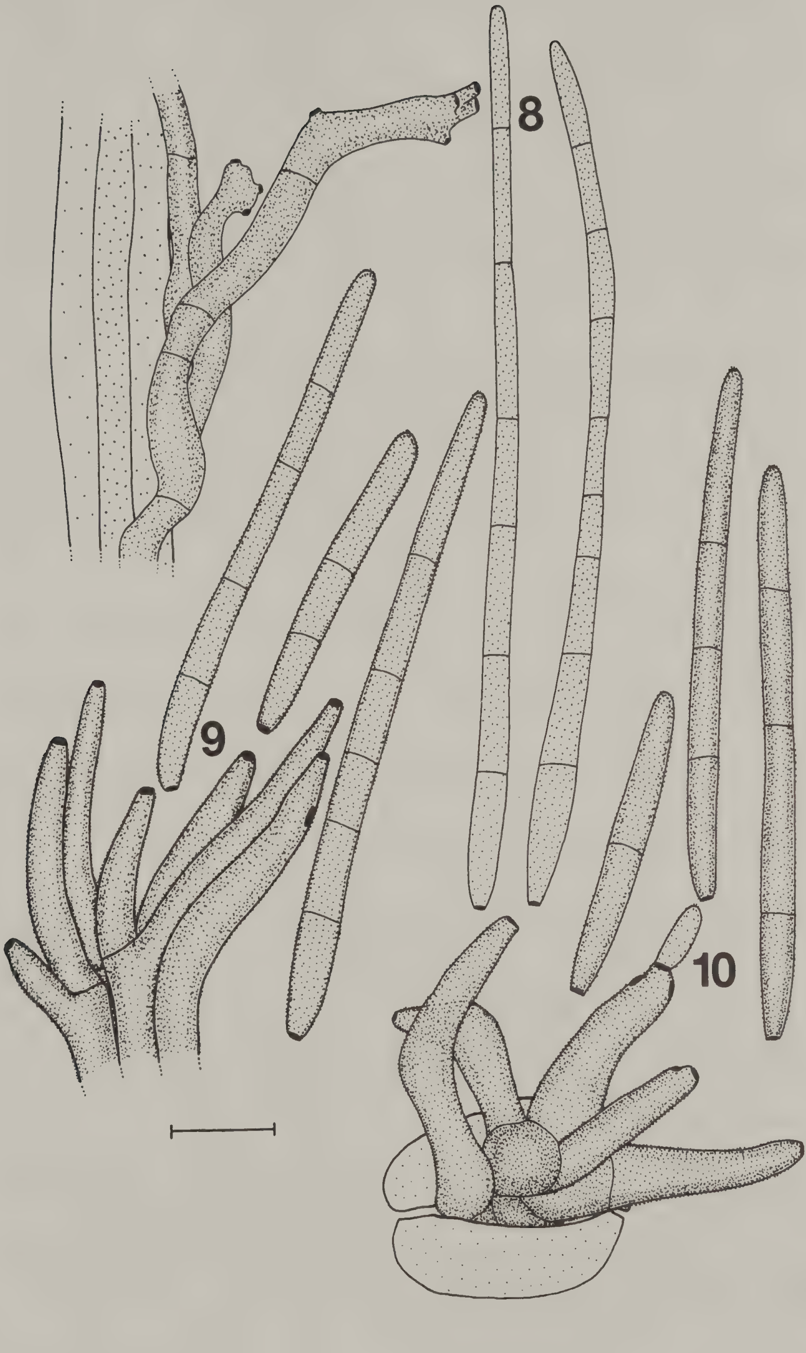
Leaf spots amphigenous, irregular, 3–10 mm diam., grey, surrounded by a thin, pale brown margin. *Pseudothecia* epiphyllous, separate, evenly dispersed, black, subepidermal, globose, up to 90 µm wide; apical ostiole papillate, 10–15 µm diam.; wall consisting of 2–3 layers of medium brown *textura angularis*, hymenium layer at base consisting of 1–2 layers of hyaline cells. *Asci* aparaphysate, fasciculate, bitunicate, subsessile, obovoid to ellipsoid, straight to incurved, 8-spored, 20–30 × 8–10 µm. *Ascospores* bi- to tri-seriate, overlapping, hyaline, guttulate, thin-walled, straight to slightly curved, fusoid-ellipsoidal with obtuse ends, widest in the middle of the apical cell, medianly 1-septate, not constricted at the septum, tapering towards both ends, but more prominently towards the lower end, 8–13 × 2.5–3 µm. *Mycelium* internal and external, composed of verruculose, branched, light brown hyphae, 3–4 µm diam. *Caespituli* amphigenous, medium brown, up to 100 µm wide. *Conidiophores* aggregated in dense fascicles, arising from the upper cells of a brown stroma up to 80 µm wide; conidiophores medium brown, verruculose, subcylindrical, 0–4-septate, straight to geniculate-sinuous, unbranched, 12–70 × 3–4 µm. *Conidiogenous cells* terminal, light brown, finely verruculose, tapering to flat-tipped apices, with darkened, thickened, refractive conidial scars, proliferating sympodially, 12–25 × 2.5–3.5 µm. *Conidia* solitary, olivaceous, finely verruculose, narrowly obclavate, apex subobtuse, base long obconically truncate, straight to mildly curved, 1–14-septate, 15–120 × 2.5–4 µm; hila thickened, darkened, refractive.

Host(s) & Dist.: *Shorea* spp. (Dipterocarpaceae); India.

Specimen examined: India, Bangalore, Bannerguatea, living leaves of *Shorea talura* Roxb., M.J. Thirumalachar, 28 Dec. 1944, BPI 441189 (holotype).

Deighton (1976) placed this species in *Pseudocercospora*. It is, however, better accommodated in *Stenella* Syd. based on the thickened conidial loci and verruculose, superficial hyphae. The thickening of the conidial scars is very slight, and more prominent in smaller conidia and conidiogenous cells than on the hila of larger conidia. Chupp's original description gives conidia as being smaller (15–60 × 2–4 µm), but was chiefly based on the epiphyllous fructifications, which are less well-developed than those on the hypophyllous surface.

Figs 8–10. Conidiophores and conidia of *Passalora querci* (Fig. 8), *Stenella salicis* (Fig. 9) and *Stenella solidaginis* (Fig. 10). Bar = 10 µm.



30. *Stenella salicis* (Chupp & H.C. Greene) Crous & U. Braun, comb. nov. Fig. 9

≡ *Cercospora salicis* Chupp & H.C. Greene, *Am. Midland Naturalist* **41,** 757 (1949).

Leaf spots amphigenous, irregular to angular, 0.5–2 mm diam., dark brown, coalescing with age. *Mycelium* internal and external, composed of verruculose, branched, light brown hyphae, 3–4 µm diam. *Caespituli* epiphyllous, brown, up to 60 µm wide. *Conidiophores* aggregated in dense fascicles, arising from the upper cells of a brown stroma up to 50 µm wide; conidiophores light brown, verruculose, subcylindrical, 1–3-septate, straight to geniculate-sinuous, mostly unbranched, 15–45 × 4–6 µm. *Conidiogenous cells* terminal, light brown, finely verruculose, tapering to flat-tipped apices, with darkened, thickened, refractive conidial scars, proliferating sympodially, 10–20 × 3–4 µm. *Conidia* solitary, light brown, finely verruculose, obclavate to obclavate-subcylindrical, apex obtuse, base obconically truncate, straight to mildly curved, 1–6-septate, 20–60 × 3–4.5 µm; hila thickened, darkened, refractive.

Host(s) & Dist.: *Salix* spp. (Salicaceae); U.S.A.

Specimen examined: U.S.A., Wisconsin, Madison, living leaves of *Salix alba* L., H.C. Greene, 28 Sept. 1948, BPI 440981 (holotype).

Since verruculose external hyphae are present, this species is better placed in *Stenella*.

31. *Stenella solidaginis* (Chupp & H.C. Greene) Crous & U. Braun, comb. nov. Fig. 10

≡ *Cercospora solidaginis* Chupp & H.C. Greene, *Trans. Wis. Acad. Sci. Arts Lett.* **36,** 267 (1946).

Leaf spots indistinct, with effuse, amphigenous fruiting. *Mycelium* internal and external, composed of verruculose, branched, light brown hyphae, 3–4 µm diam. *Caespituli* medium brown, up to 40 µm wide. *Conidiophores* arising singly from superficial mycelium, or aggregated in loose to dense fascicles, arising from stomata; stroma inconspicuous, or restricted to a few medium brown cells; conidiophores light brown, finely verruculose, subcylindrical, 0–7-septate, straight to geniculate-sinuous, mostly unbranched, 10–50 × 4–6 µm. *Conidiogenous cells* terminal, unbranched, light brown, finely verruculose, tapering to flat-tipped apices, with darkened, thickened, refractive conidial scars, proliferating sympodially, 10–20 × 2.5–5 µm. *Conidia* solitary, light brown, finely verruculose, narrowly obclavate to subcylindrical, apex subobtuse, base long obconically truncate, straight to mildly curved, 1–7-septate, 15–50 × 3–5 µm; hila slightly thickened and darkened.

Host(s) & Dist.: *Solidago* spp. (Compositae); India, Japan, U.S.A.

Specimen examined: U.S.A., Wisconsin, Madison, living leaves of *Solidago juncea* Aiton, H.C. Greene, 18 Aug. 1943, BPI 441413 (holotype).

Verruculose external hyphae with solitary conidiophores and thickened, darkened conidial scars clearly refer this species to *Stenella*.

Acknowledgements

The authors wish to thank Mrs J. O'Donnell and Dr. A.Y. Rossman, for allowing us to examine these specimens lodged at BPI, Beltsville, U.S.A. Dr. J.E. Taylor and Mrs S. Denman are thanked for their comments on the script.

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MYCOTAXON

Volume LXXVIII, pp. 345-347 April-June 2001

PUCCINIA AUSTROYUNNANICA SP. NOV. ON GOUANIA*

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ABSTRACT: A new rust species, *Puccinia austroyunnanica*, parasitic on *Gouania leptostachya* (Rhamnaceae) collected from Xishuangbanna of tropical China is described and illustrated. The relationship of the new species to other known allied species on the same host genus is briefly discussed.

KEY WORDS: rust fungi; *Gouania leptostachya*; Rhamnaceae; new species; China

In this paper the authors report the recent discovery of a new rust species parasitic on *Gouania leptostachya* DC. belonging to Rhamnaceae. Only one collection is known, which was collected from Xishuangbanna of southern Yunnan in the south to the Tropic of Cancer adjacent to Burma and Laos. The type collection is deposited in Herbarium Mycologicum Academiae Sinicae (HMAS), Beijing.

Puccinia austroyunnanica J.Y. Zhuang & S.X. Wei sp. nov. Fig. 1

Uredinia hypophylla, sparsa, parva, rotundata, ca. 0.1-0.5 mm diam., in vivo flava, in sicco pallescentia, nuda, pulverulenta, paraphysibus clavatis vel utriculatis plus minusve incurvatis ad basin uniseptatis 25-75 μ m longis 7-12 μ m latis hyalinis tenuiter tunicatis cincta; urediniosporae obovoideae, ellipsoideae vel piriformes, 22-33×17-25 μ m, membrana 1.5-2 μ m crassa, valde echinulata (aculeis spatio 2.5-4 μ m separatis), pallidissime flavida vel hyalina, pori germinationis obscuri.

Telia hypophylla, sparsa vel pauce aggregata, rotundata, ca. 0.2-0.5 mm diam., nuda, castaneo-brunnea, pulverulenta; teliosporae ellipsoideae vel oblongae, 33-48×20-30 μ m, utrinque rotundatae, ad septum non vel vix constrictae, membrana uniformiter 3.5-5 μ m crassa, ubique dense grosseque verrucosa, cinnamomeo-brunnea vel castaneo-brunnea, pori germinationis obscuri, pedicellus hyalinus, usque ad 75 μ m longus, persistens.

Hab. in foliis Gouaniae leptostachyae DC. in regione Xishuangbanna yunnanica in Sina tropica, alt. 500 m, 6 I 1976, leg. R.Y. Zheng no.326 (HMAS 80415, holotypus).

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* Supported by the National Natural Science Foundation of China Grant No. 39730020

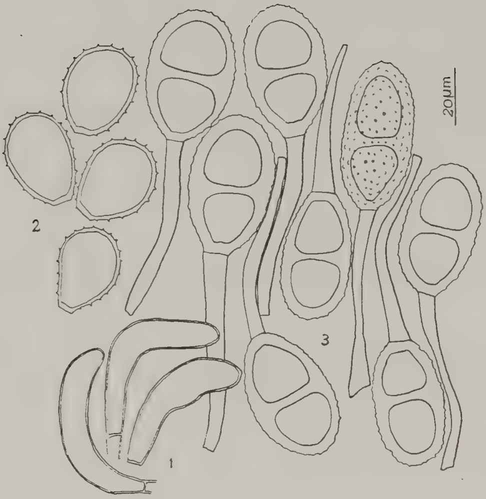

Fig. 1 *Puccinia austroyunnanica* J.Y. Zhuang & S.X. Wei sp. nov. (HMAS 80415). Uredinial paraphyses (1), Urediniospores (2) and teliospores (3).

This is a very striking species in all its characters. The remarkable more or less incurvate basally 1-septate hyaline paraphyses and the unusual appearance of the teliospores with coarse verrucae quickly arrest attention. No trace of spermogonia or aecia could be detected.

Six species of *Puccinia* have been recorded on *Gouania* (Holway, 1905; Dietel, 1908; Spegazzini, 1912; Arthur & Johnston, 1918; Sydow & Petrak, 1931; Cummins, 1939). *P. gouaniae* Holway from West Indies Is., Central and South America bears a strong resemblance to our species in microscopic appearance and measurements of uredinial paraphyses, urediniospores and teliospores. The type specimen of *P. gouaniae* made at Gebara, Cuba, by E.W.D. Holway in 1903 on *Gouania polygama* (Jacq.) Urban, Barth. N. Amer. Ured. No.544, has been examined and found unlike our species in some details of urediniospores. The urediniospores of *P. gouaniae* are obovoid or triangular-obovoid, dark cinnamon-brown, with conspicuous 2-3 equatorial or superequatorial germ pores. Judging from original descriptions, other five known species seem very different: *P. invaginata* Arthur & J.R. Jonston from Cuba and Mexico (see also Leon Gallegos & Cummins, 1981) has urediniospores introverted from the side and appearing arcuate to obovoid-arcuate and much shorter teliospores with shorter and fragile pedicels; *P. gouaniae-tiliaefoliae* Sydow apud Sydow & Petrak from Philippines has much smaller teliospores being 26-30×19-22 μ m; *P. incallida* Cummins from Ghana and *P. paraensis* Dietel from Brazil (see also Hennen, Hennen & Figueiredo, 1982) have thin-walled, colourless and smooth teliospores; *P. gouaniicola* Spegazzini from Argentina is to be considered a short-cycle form, having broadly ellipsoid teliospores measuring 35-38×25-28 µ m.

ACKNOWLEDGMENT

The authors are indebted to Dr. H.B. Gjaerum, Norwegian Crop Research Institute, Ås, Norway for serving as pre-submission reviewer.

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MYCOTAXON

Volume LXXVIII, pp. 349-351 April-June 2001

SOME NOTEWORTHY TROPICAL SPECIES OF UROMYCES FROM HAINAN ISLAND*

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ABSTRACT: Three species of the genus *Uromyces* found in Hainan Island of South China are reported. *Uromyces hainanicus* is described as a new species. *Uromyces blandus* and *U. kunigamiensis* are new records in China.

KEY WORDS: rust fungi, new species, new records, China

In a survey of the rust fungi in Hainan Island of China, some less frequently occurring species of the genus *Uromyces* were found, among them two were new to China, and one was distinctly different from any previously described and proposed as new to science. The specimens studied have been deposited in Herbarium Mycologicum Academiae Sinicae (HMAS), Beijing.

Uromyces blandus H. Sydow, Ann. Mycol. 29: 145, 1931.

On *Phragmites communis* Trin., Hainan: Mt. Jianfengling, 2 IV 1993, J.Y. Zhuang & S.X. Wei 5098 (HMAS 77389).

The urediniospores are globoid or broadly ellipsoid, 23-30×22-26 μ m, with 3-4 equatorial germ pores. The teliospores are globoid, obovoid or broadly ellipsoid, 25-38×18-27 μ m, with smooth wall 5-10 μ m thick at apex.

This is the first record of the species for China, being previously known only from Philippines. All collections so far seen have been found to be on *Phragmites communis* Trin. (Sydow & Petrak, 1931; Cummins, 1971).

Uromyces hainanicus J.Y. Zhuang & S.X. Wei sp. nov. Fig. 1

Telia hypophylla, rotundata, ca. 0.2-0.5mm diam., sparsa vel in greges rotundatos 1-2mm latos densissime constipata tandem plerumque omnino confluentia, nuda, valde pulvinata, compacta, castanea; teliosporae ellipsoideae, obovoideae vel aliquantum variabiles, 20-38×13-20 μ m, apice rotundatae, basi rotundatae vel leniter attenuatae, membrana ad latera tenuissima ca. 1 μ m vel minus crassa, ad apicem 3-12 μ m incrassata, laevis, flavo-brunneola, pedicellus hyalinus 20-60 μ m longus,

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* Supported by the National Natural Science Foundation of China Grant No.39730020

persistens.

Hab. in foliis Ipomoeae sumatranae (Miq.) Ooststr. in monte Limuling in insula Hainan sino-tropica, alt. 700m, 25 VI 1960, leg. J.H. Yu & R. Liu 1612 (HMAS 80416, holotypus).

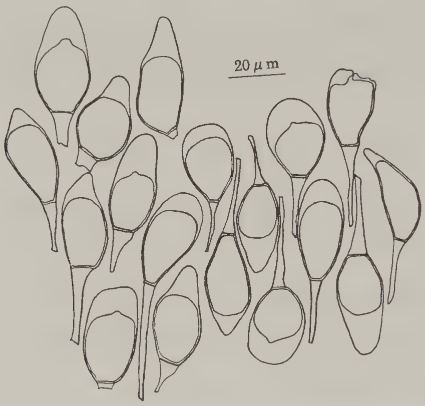

Fig. 1 Teliospores of *Uromyces hainanicus* J.Y. Zhuang & S.X. Wei sp. nov. (HMAS 80416)

The collection shows teliospores only, and no trace of spermogonia could be found. The appearance of the rust is wholly unlike that of other six *Uromyces* species hitherto known on *Ipomoea*. Telia are often in groups on discoloured rounded spots, compact, coalescent, forming large cushion-shaped sori. The teliospores are ellipsoid, obovoid or irregular, smooth, with yellowish-brown walls strongly thickened at the apex. Some spores are seen to be denticulate at the apex, apparently as the result of the throwing off of the thickening part during germination. The species appears to be a lepto-form.

The rust is quite distinct from *Uromyces ipomoeae* (Thümen) Berkeley (see Sydow, 1910) from South Africa and *U. pieningii* Cummins (1960) from Ghana because the teliospores of the latter two species are conspicuously spheroidal with radiately striations. *Uromyces comptus* P. & H. Sydow (1910) from South Africa is also decidedly different in teliospores which are thick-walled (4-6 μ m) and papillate apically. *Uromyces vicinus* H.S. Jackson & Holway (Jackson, 1931) from Brazil has teliospores of somewhat similar shape and size as well as wall thickness but with short and deciduous pedicels. It differs also in the presence of uredinial stage. There are two microcyclic species of *Uromyces* already recorded upon *Ipomoea*, viz., *U. greenstockii* Doidge (1927) from South Africa, and *U. pachyceps* Lagerheim apud P. & H. Sydow (1910) from Ecuador. *U. greenstockii* differs in having teliospores with hemispherical subhyaline papilla and verrucose wall, and *U. pachyceps* differs in having elongated nearly hyaline thin-walled teliospores.

Uromyces kunigamiensis Shimabukuro ex Hiratsuka f., Sci. Bull. Div. Agr., Home Econ. & Engin., Univ. Ryukyu 7: 232, 1960.

On *Fimbristylis* sp., Hainan: Mt. Diaoluoshan, 8 VI 1960, J.H. Yu & R. Liu 2826 (HMAS 52020); Mt. Limuling, 10 VII 1960, J.H. Yu & R. Liu 1800 (HMAS 52021).

The collections show abundance of uredinia, but no telia. The urediniospores are globoid, obovoid or ellipsoid, 22-30×17-25 μ m, with cinnamon-brown wall 2.5 μ m thick and 2 equatorial germ pores. The characters agree well with the description of this *Fimbristylis* rust (Hiratsuka, 1960). Although heretofore the rust was recorded only from Ryukyu Is., the extension of its distribution in Hainan I. seems possible.

ACKNOWLEDGMENT

The authors are indebted to Dr. H.B. Gjaerum of Norwegian Crop Research Institute, Ås, Norway for serving as pre-submission reviewer.

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MYCOTAXON

Volume LXXVIII, pp. 353-361 April-June 2001

STEGOLERIUM KUKENANI GEN. ET SP. NOV. AN ENDOPHYTIC, TAXOL PRODUCING FUNGUS FROM THE RORAIMA AND KUKENAN TEPUIS OF VENEZUELA

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ABSTRACT

Stegolerium kukenani gen. et sp. nov. is described as a hyphomycetous species associated as an endophyte with *Stegolepis guianensis* on the summits of the Roraima and Kukenan tepuis of Venezuela. The genus is characterized by arthrocatenate conidia which vary from ovoid, obpyriform, dumbbell to spherical in shape and do not possess cross walls. The spores and hyphae have micro-fine protrusions and brownish, slightly thickened walls. The conidia commonly contain 3-10 readily discernable lipid bodies and are catenate in the hyphae. They germinate into one or more germ tubes arising per conidia. The fungus produces numerous dark brown sclerotia (0.2-0.6 mm in diameter) and loosely consolidated hyphae in culture. No other endophyte was obtained from this plant. Each isolate produced taxol as measured by a monoclonal antibody technique.

Keywords: conidia, endophyte, taxol, tepui, Venezuela

INTRODUCTION

The southeastern portion of Venezuela, also known as the Guyana region, contains nearly 100 relatively flat-topped mountains known as tepuis. These tepuis rise 1-2 miles above from the rain forest floor below. Because of their altitude and geographical location, the tepuis have weather patterns that differ dramatically from the areas at or below their bases. Very commonly, the tepui tops are enshrouded with clouds, and cool but not freezing temperatures (Steyermark et al., 1995). This area of the world possesses a fascinating geological history in that it consists of sandstone sediments that apparently arose from the erosion of mountains of an upland area in what is now West Africa. These events occurred about 1.5 billion years ago when the continents were joined into Gondwana land. After the continents separated, differential erosion of the sediments resulted in a remarkable pattern on the landscape of table-topped mountains interspersed with wide valleys and a myriad of rivers. Since these events took place in a tropical part of the world, plants have taken up residence in virtually every nook and cranny of this area. In fact, the unique weather patterns associated with the tepui tops have resulted in an environmental-based selection of several hundred plants that are endemic to only this small part of the world. For instance, most of the tepuis have annual rainfalls exceeding 250 cm per annum. Although frost almost never occurs, the tepui tops are nevertheless quite cool. They are considered to range from mesothermic to submicrothermic (mean annual temps from 8-12°C) (Steyermark et al., 1995). On many tepuis, one of the most prevalent plants is *Stegolepis* spp. (Rapateaceae) an endemic group having relatives in West Africa. This genus is represented by at least 17 species that play a dominant role in the tepui ecosystem. *Stegolepis* spp. have a series of two sets of numerous broad strap-like leaves located on either side of a central stem. These leaves glisten in the sunlight making the plant one of the most noticeable of all plants on the tepuis. In a search for novel endophytes that make interesting and useful biochemicals we have selected tropical and semi-tropical areas of the world having endemic plants to serve as source material. The rationale for searching such areas is that endemic plants may be hosts to microbes that are likewise unique to them. This approach was validated by our discovery of *Seimatoantlerium tepuiense* as an epiphyte from *Maguirethamnus speciosus* growing in the Venezuelan-Guyana (Strobel et al., 1999). Thus, in this report we describe another unique endophyte from this same region of the world but from a different plant species.

MATERIALS AND METHODS

Stegolepis guianensis Klotczh ex Koern. samples were collected from the Roraima and Kukenan tepuis which were accessed by helicopter. They were immediately placed at 4°C until transported, by air, to the laboratory. Pieces (0.5 x 0.5 cm) of various parts of *S. guianensis* were immersed in 70% ethanol and the ethanol was then allowed to evaporate under a sterile hood (Li et al., 1996). Dead outer plant tissues were removed with a scalpel. Small pieces of inner tissues were aseptically removed and placed on a Petri plate containing water agar. After incubation for several days, hyphal tips of developing fungi were aseptically removed and placed on potato dextrose agar (PDA). Fungal colonies that seemed to be pure were also allowed to continue to develop on the sterilized plant tissues. After 14 days, fungal colonies were transferred to both sterilized *S. guianensis* leaf pieces and gamma irradiated carnation leaves (0.5 x 0.5 cm) to encourage spore production. Sclerotia production was greatest on PDA containing carnation leaf pieces and they appeared abundantly after 6 weeks at 22°C.

Leaves and other plant parts supporting fungal growth were placed into distilled water with one drop per 10 ml of Triton X 100 (wetting agent) and aspirated for 5 min. (Strobel et al., 2000). The fungal preparation was then placed into 2% glutaraldehyde in 0.1 M sodium cacodylate buffer (pH 7.2-7.4) and left overnight. The next day they were washed in six 15-min-changes of water buffer, followed by three 15-min-changes in 10% ethanol, four 15-min-changes of 30%

ethanol, five 15-min-changes of 50% ethanol and left for two days in 70% ethanol. They were then rinsed in five 15-min-changes of 95% ethanol and five 15-min-changes in 100% ethanol. The dehydration process was done slowly to discourage the process of spore shriveling which occurs during rapid dehydration. Ultimately, the fungal material was critically point dried, gold sputter coated and examined with a JEOL 6100 scanning electron microscope (SEM). Light micrographs were taken on sample material freshly prepared from agar plates, mounted on a glass slide and photographed at 400x.

Several isolates of the endophyte of *S. guianensis* were grown in 10 2-l Erlenmeyer flasks containing 500 ml of MID medium supplemented with 1 g of soytone per liter (Strobel et al., 1996). The fungus cultures were incubated for 3 weeks at 22°C under still conditions. Mycelia were removed from the culture fluid by passage through 4 layers of cheesecloth. The culture fluid was extracted with two equal volumes of methylene chloride in order to extract the lipid soluble compounds. All other chromatographic methods to acquire taxol were used as previously described (Strobel et al., 1999). The taxol content of each culture was determined by a competitive inhibition immunoassay method (CIEIA) using a taxol immunoassay kit (Hawaiian Biotechnology Group, Aiea, Hawaii) (Grothaus et al., 1993). Detection was by an alkaline phosphatase reaction with standardization using a curve constructed with a taxol standard supplied with the immunoassay kit. The sensitivity of the assay is ± 1.0 mg per ml and is extremely taxol specific.

RESULTS AND DISCUSSION

Stegolepis Endophytes

Several individual entire *Stegolepis guianensis* plants were collected from the Roraima and Kukenan tepuis in southern Venezuela (Fig. 1). These were examined for endophytic fungi associated with stems, roots and leaves. From each of these plant parts, only one fungus emerged which was common to all of the plant samples. Each isolate was designated in the F(V) series of our culture collection. These brownish-gray fungal colonies grew slowly from the ethanol treated plant parts when placed on water agar. Hyphae became obvious only after 10-14 days and as they began to show submerged growth in the agar. After transfer to PDA plates the mycelium that developed was also brownish and mostly submerged beneath the agar surface (Fig. 2). However, after further (1-2 weeks) incubation some hyphae became aerial on the plant parts and were placed in fixative and examined by SEM (Figs. 3-5). Aerial hyphae were also obtained by sterilizing the leaves of *S. guianensis*, placing them on water agar and inoculating them with the fungus. The fungus also produced aerial hyphae on carnation leaves incubated on PDA plates. The hyphae and spores grown in culture were identical to hyphae and spores from leaf surfaces (Fig. 6). Furthermore, the fungus produced sclerotia with loosely consolidated hyphae on PDA plates containing sterile carnation leaves after 6 weeks incubation at 22°C (Fig. 6). These sclerotia were 100% viable and readily germinated after 1-2 days incubation on PDA plates at 22°C.

Fungal Taxonomy

Stegolerium kukenani Strobel, Hess, and Ford gen. et sp. nov. (Figs. 2-6).

***Fungus** in natura Stegolepide guainensi consociatus. Coloniae fungales in agaro effusae et submersae. **Mycelium** hypharum brunneolarum ramosarum septatarum compositum, hae 2-3 µm in diam., hyphis aeriis plerumque convolventibus, et protrusionibus irregularibus in hyphis et arthrosporis et apparentibus. **Conidia** arthrocatenata, ovoidea, obipyriformia, ossiformia ad sphaerica, brunneola parietibus parum incrassatis, 7-10 x 2-9 µm, guttis olei 3-10; tubis germinalibus unis vel pluribus germinantes. Conidium terminale capitatum, 3-8 µm in diam. Sclerotia laxe consolidata brunnea (0.2-0.6 mm in diam.) in culturae formari possunt (Fig. 6).*

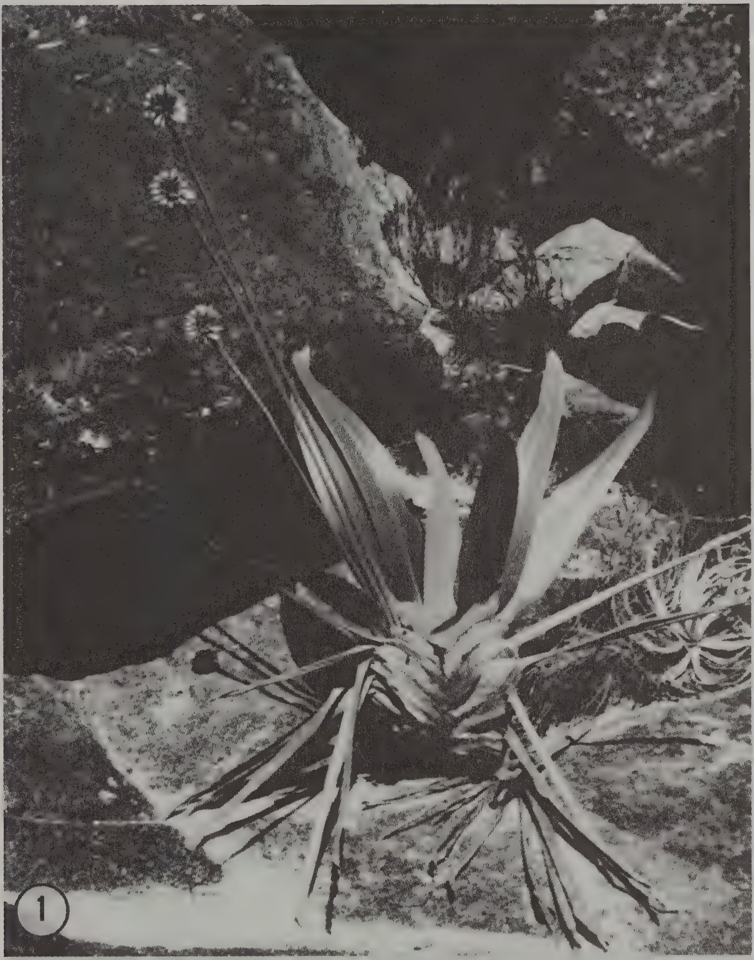
Fungus in nature associated with *Stegolepis guainensis*. Fungal colonies effuse and submerged in agar. **Mycelium** composed of septate, branched, brownish hyphae 2-3 µm in diam., with aeral hyphae commonly intertwining, and with irregular protrusions appearing on both hyphae and conidia. **Conidia** arthrocatenate, ovoid, obpyriform, dumbbell to spherical, aseptate, brownish with slightly thickened walls, 7-10 x 2-9 µm, with 3-10 lipid bodies; germinating by one or more germtubes. Terminal conidium capitate, 3-8 µm diam. Loosely consolidated brown sclerotia (0.2-0.6 mm in diam.) can form in culture (Fig. 6).

Holotype: Endophytic on *Stegolepis guianensis*. Collections were made on the Kukenan and Roraima tepuis in the Venezuelan-Guyana region of Venezuela. The holotype comes from only one site—the Kukenan tepui located in Venezuela near the borders of Brazil, Guyana and Venezuela. Specimens examined. Venezuela, Venezuela-Guyana region: Kukenan and Roraima tepuis, endophytic on *Stegolepis guianensis*, collected on Jan. 15, 1998, by Gary and Suzan Strobel. Dried culture deposited in Montana State University herbarium (MONT) as Strobel F(V)S1 (HOLOTYPE).

Telomorph: Unknown

Etymology: The prefix to the genus name given to this fungus has its origin in the name of the host plant from which it is most commonly obtained, which is *Stegolepis*. The species (*kukenani*) is derived from the tepuis which is the geological home of both the host plant and the fungus—hence: *Stegolerium kukenani*.

The fungus differs from other typical arthrocatenate conidia producing fungi such as *Scytalidium* sp. and *Bahusakala* sp. in that the spores are not cylindrical as in the latter and they are not ellipsoidal-doliform as in the former. These comparisons were made by comparing the published photographs of these already known fungi (Ellis, 1976). Attempts to induce fruiting structures, other than conidia or sclerotia, either on gamma-irradiated carnation leaves or on sterilized leaf tissue of *Stegolepis guianensis,* were not successful. However, the fungus did produce aerial hyphae on *S. guianensis* and carnation leaves and we could successfully fix



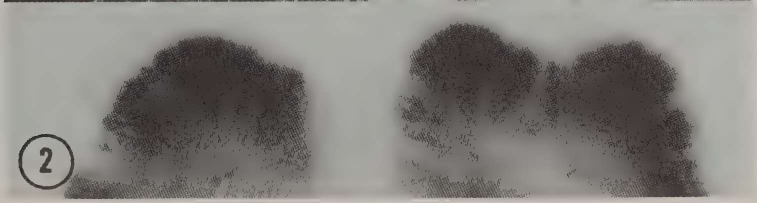
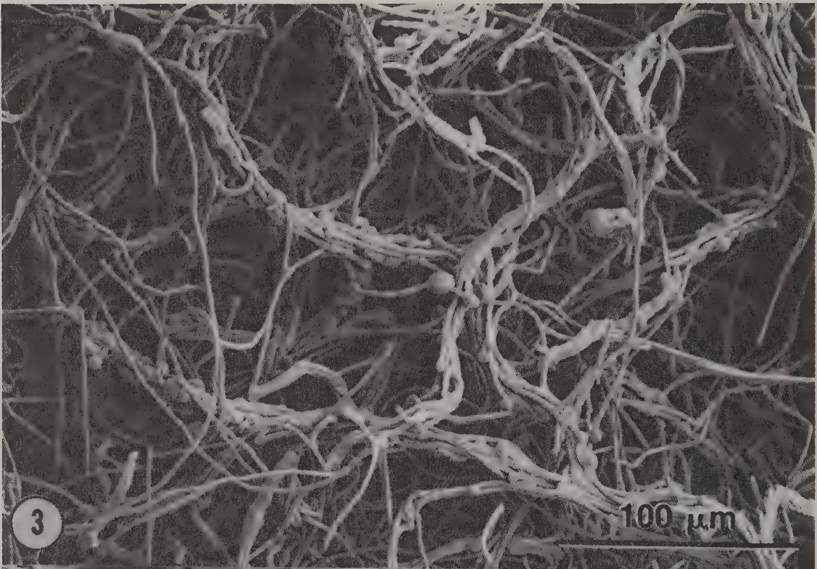


Fig. 1. *Stegolepis guianensis* growing on the Kukenan tepui in Venezuela.
Fig. 2. A light micrograph of *Stegolerium kukenani* in culture on water agar after 28 days.



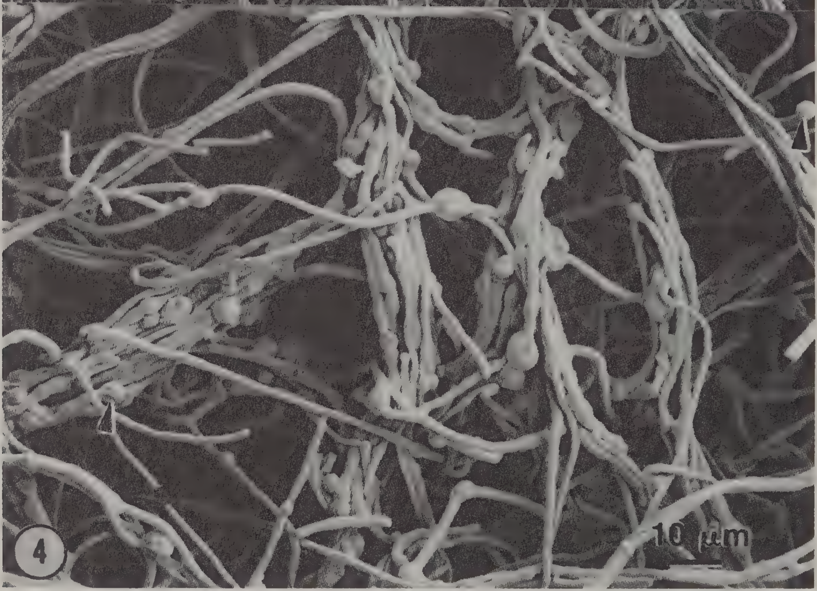
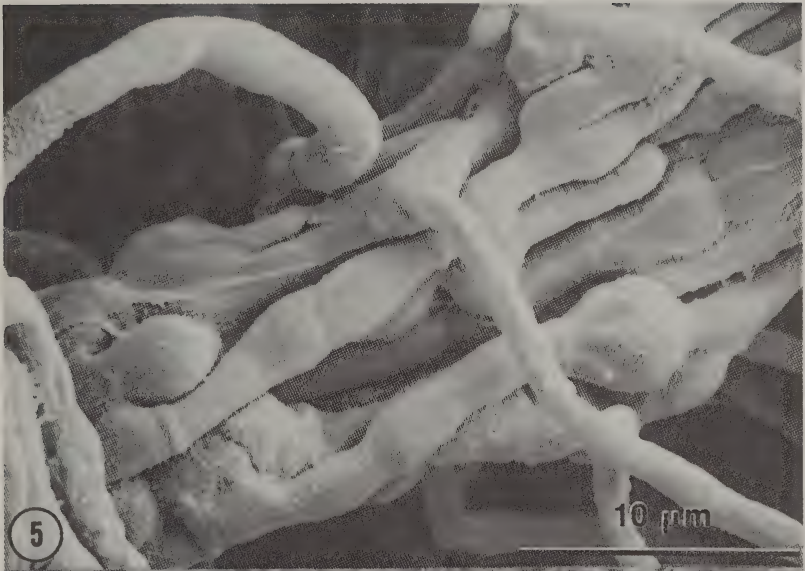


Fig. 3. A scanning electron micrograph of *Stegolerium kukenani* in culture showing the characteristic developing arthrocatenate conidia and hyphae. Bar=100 µm.
Fig. 4. A scanning electron micrograph of *Stegolerium kukenani* in culture showing arthrocatenate conidia, some of which are terminal (see arrows). Bar=10 µm.



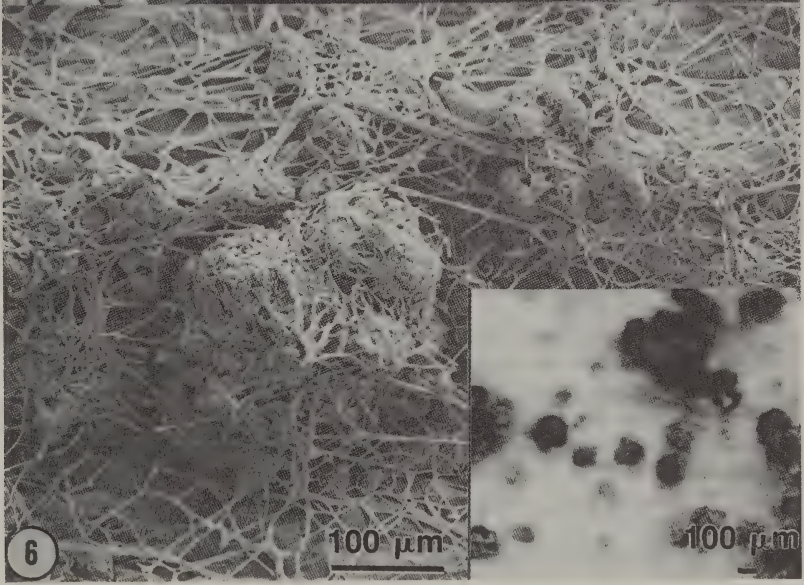


Fig. 5. A scanning electron micrograph of *Stegolerium kukenani* grown on a leaf surface showing developing arthrocatenate conidia and characteristic microstructural protrusions on developing conidia and hyphae cells. Bar=10 µm.

Fig. 6. A scanning electron micrograph of *Stegolerium kukenani* sclerotia on a carnation leaf surface. Bar=10 µm. Inset: A light micrograph of sclerotia on a carnation leaf surface. Bar=100 µm.

and photograph this material (Figs. 3-4). Also, abundant sclerotia which appears unlike *Scytalidium* sp. and *Bahusakala* sp. were formed on PDA containing sterile carnation leaves. It was also on this material that numerous terminal conidia were noted (Fig. 4). We suspect that many of the obpyriform, dumbbell, or other peculiarly shaped conidia may simply represent conidia in various stages leading to the development of the final spheroidal arthrocatenate conidia (Figs. 4-5). Sometimes the terminal conidium does not dehisce at the base of the spheroidal hyphal enlargement, but several micrometers below on the supporting hypha (Fig. 4). We attribute any gross surface structural irregularities on the spores to difficulties in obtaining perfect fixation of the hyphae. However, both the hyphal and conidia surfaces, as observed in the SEM, seem to have fine microstructural protrusions giving these structures a sandpaper or rough appearance (Fig. 5).

Fungal Biology

A number of different plant species that live adjacent to *Stegolepis guianensis* on the two tepui tops (Roraima and Kukenan) were also examined for their endophytic fungi. Although many endophytic fungi were recovered from these plants, none fit the description of *S. kukenani.* Representative plants of those genera sampled included *Heliamphora* sp., *Schleffera* sp., *Belfaria* sp., *Lindermania* sp., *Maguireothamnus speciosus*, *Bonnita* sp., and *Tillandsia* sp. As a result of this observation we are led to suspect that *S. guianensis* may be host selective or possibly host specific.

Furthermore, it is to be noted that only one species of a total of 17 of *Stegolepis* spp. that inhabit the tepui ecosystem was sampled for its endophytic fungi. It would be interesting to know if other species of this plant genus on other tepuis also are host to *S. kukenani* or perhaps to other unidentified fungi. What is more interesting, however, is to speculate why the endophytes exist with these tepui plants and what their role is to the biology and survival of the species. In some cases a symbiotic relationship between the fungus and the plant has been suggested. If such were the case, then the contribution of the fungus to the relationship and vice versa needs to be established. The plant is the source of nutrients for the fungus, but the role of the fungus to the host is a more difficult arrangement to firmly establish. Taxol is commonly produced by rainforest endophytes (Strobel, et al., 1996). We did observe that each of the isolates of *S. kukenani* produced detectable quantities of taxol eg. F(V) L1=7.1; F(V)L3=18.9; F(V)L4=7.2; F(V)C1=9.3 and F(V)S1=10.5 ng per liter, respectively. One possibility is that the ability of the isolates of *S. kukenani* to produce taxol may be linked to the protective effect that taxol may provide to the plant from potential threats from attack by pathogenic oomycetes (Young et al., 1992). However, the amount of taxol produced per liter per culture is extremely low. In situ it is conceivable that the fungus may produce larger quantities of this compound. Thus, the endophytic fungus would be contributing to the survival of the plant and the role of the fungus could be considered more symbiotic than saprophytic or commensal.

ACKNOWLEDGEMENTS

The authors appreciate the financial help of the Montana Agricultural Experiment Station, the MSU Research Administration and Cytoclonal Pharmaceutics of Dallas Texas.

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MYCOTAXON

Volume LXXVIII, pp. 363-392 April-June 2001

THE SOREDIATE SPECIES OF THE GENUS MENEGAZZIA (PARMELIACEAE, LICHENIZED ASCOMYCOTINA) IN SOUTHERNMOST SOUTH AMERICA

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ABSTRACT

The taxonomy, ecology, chemistry and distribution of sorediate species of the genus *Menegazzia* from the southernmost parts of Chile (the Magellanic Region) and Argentina (Prov. de Tierra del Fuego), and neighbouring South Atlantic islands were studied, in total 9 species. The most common species are *M. globulifera*, *M. magellanica* and *M. sanguinascens*. The latter taxon was previously misunderstood, partly because of the presence of two previously undescribed species: *M. kawesqarica*, characterized by subcapitate soralia, maculate lobes and the presence of the stictic acid chemosyndrome, and *M. chrysogaster*, characterized by a yellow internal cavity containing two unidentified pigments, glossy, contiguous lobes, and convex soralia. The remaining four species appear to be rare in the area, but are probably more widespread. *Menegazzia fumarprotocetrarica, M. neozelandica* and *M. norsorediata* are reported for the first time from southern Chile, and apothecia of the latter species are described for the first time. *Menegazzia tenuis*, the sorediate counterpart of *M. albida*, is reported for the first time from Argentina. Distribution maps and a key are provided.

RESUMEN

Se ha cumplido un estudio de la taxonomía, la ecología, la química y la distribución de las especies sorediosas del género liquenizado *Menegazzia* de la parte más austral de Chile (Región de Magallanes), Argentina (Prov. de Tierra del Fuego) y de las islas vecinas en el Mar Atlántico, en total nueve especies. Las especies más comunes son *M. globulifera*, *M. magellanica* y *M. sanguinascens*. Previamente, *M. sanguinascens* estaba malentendido, en parte debido a la presencia de dos especies previamente no descritas: *M. kawesqarica*, caracterizada por los soralia subglobosos, los lóbulos maculados y la presencia del síndrome químico del ácido stíctico, y *M. chrysogaster*, caracterizada por la cavidad amarilla causada por dos pigmentos no identificadas, los lóbulos brillantes, y los soralia convexos. Las últimas cuatro especies están raras en el área, pero probablemente tienen una distribución más amplia. Esta es la primera cita de *M, fumarprotocetrarica*, *M. neozelandica* y *M. norsorediata* para el sur de Chile, y la primera cita de *M. tenuis*, la contraparte sorediosa de *M. albida*, para Argentina. Se describen los apotecios de *M. norsorediata*. Se presentan mapas y una clave de las especies.

Keywords: lichens, *Menegazzia chrysogaster*, *Menegazzia kawesqarica,* Chile, Argentina

INTRODUCTION

The Swedish lichenologist Rolf Santesson travelled through southern South America between 1939 and 1941, and his many collections from that journey have contributed remarkably to the knowledge of South American lichens (Galloway 1998). On his return to Sweden he wrote a monograph on the southern South American taxa of *Menegazzia* A. Massal. (Santesson 1942), a study which has been the major work on the genus.

Santesson based his determinations mostly on morphological characters and on chemical spot tests. The first analytical chemical studies on *Menegazzia* from South America were those of Quilhot et al. (1975). The Argentine lichenologists Mónica Adler and Susana Calvelo reviewed the genus in Argentina (Calvelo & Adler 1994) and subsequently described two new sorediate species from Argentina (Adler & Calvelo 1996), and a key to the Argentinian-Patagonian and Fuegian species was later provided (Calvelo 1998). A further new species from Region IX to XI in southern Chile was described (Bjerke in press). *Menegazzia* and other genera with inflated lobes (*Brodoa, Cavernularia* and *Hypogymnia*) were considered to comprise the family *Hypogymniaceae* (Poelt 1974; Elix 1979; Elix & James 1992). However, neither anatomical characters (Thell et al. 1995) nor analyses of DNA segments (Crespo & Cubero 1998) support the integrity of the family *Hypogymniaceae*. Accordingly, *Menegazzia* is here considered to be a part of *Parmeliaceae*, which is in accordance with the treatment in the checklist of Chilean lichens and lichenicolous fungi (Galloway & Quilhot 1999) and the latest notes on ascomycete systematics (Eriksson 2000).

All of the taxa are corticolous, growing on trunks and branches of several phorophytes in antiboreal forests and heathlands, e.g. *Nothofagus antarctica, N. betuloides, N. pumilio, Drimys winteri, Pilgerodendron uviferum, Embothrium coccineum, Berberis* spp., *Desfontainia spinosa, Fuchsia magellanica, Gaultheria mucronata, Maytenus magellanica, Ribes magellanicum,* and *Chiliotrichum diffusum*. A few species are also facultatively saxicolous.

During field studies in southernmost Chile the present authors experienced problems in determining some groups of specimens with any of the known species of *Menegazzia*. The sorediate species especially posed problems. Therefore, a closer study of sorediate taxa in *Menegazzia* from southernmost South America was undertaken. Results of this study are presented here, and two new sorediate species are described.

MATERIAL AND METHODS

Material of *Menegazzia* collected by the authors in Chile (mostly deposited in TROM), in addition to material from their total distribution areas and material of extra-American sorediate species deposited in the herbaria AAS, BG, H, HIP, HO, O, S, UPS and UV were examined. Identification of acetone-soluble substances was carried out by thin layer chromatography following Culberson & Kristinsson (1970), Culberson (1972, 1974), Culberson et al. (1981) and White & James (1985). Anatomical studies were carried out following Malcolm & Galloway (1997).

Distribution maps for the treated taxa in southernmost South America are provided. Southernmost South America is here defined as the southernmost counties in Chile and Argentina, namely 'Región XII de Magallanes y de la Antártica Chilena' (in English known as the Magellanic Region) and 'Provincia Tierra del Fuego, Antártica e Islas del Atlántico Sur', respectively. Both of the counties include Antarctic sections, which are excluded from the present study as none of the studied species occurs there. Comments on the distribution of species of *Menegazzia* on the subantarctic South Atlantic Islands are also included. Distribution maps are based on our own records and collections, examined herbarium material and some literature reports. All reports in Calvelo & Adler (1994) and Adler & Calvelo (1996) from the study area are included in the maps. The records of *M. globulifera* and *M. tenuis* in Santesson (1942) are also included. The remaining published reports that were not able to be verified from examination of herbarium material are considered too doubtful to be included. Examined specimens not from the study area are cited only in exceptional cases. Much of the material cited by Santesson (1942) and deposited in UPS and S, including most type specimens, was on loan, and was not available to us.

The lichen distribution is compared with a revised treatment of the vegetation regions of the Magellanic Region and Tierra del Fuego under preparation by Elvebakk, and a preliminary version is used here (Fig. 1). The major vegetation regions from west to east are as follows: 1. Antiboreal Magellanic moorland, 2. Antiboreal rainforest, 3. Antiboreal deciduous forest, 4. Antiboreal *Chiliotrichum-Empetrum* heathland, and 5. Temperate *Festuca gracillima-Stipa* steppe. From about latitude 51° S and northwards, temperate rainforest is predominant. Some smaller areas with other steppe types are also present outside the distribution area of *Menegazzia*.

RESULTS AND DISCUSSION

Soralia

Vegetative propagules are of major importance in distinguishing the predominantly non-fertile species. Phyllidia and other lobulate vegetative dispersal units are not known from *Menegazzia*. Isidia are found in a few extra-American species. Soralia are therefore the dominant type of vegetative propagule in *Menegazzia*. Of the 17 known southern South American species, ten are sorediate. A wide variety of soralium types is found in these species:

1. Maniciform soralia ('soredia maniciforma' *sensu* Du Rietz 1924).

According to Du Rietz (1924), this type is only found in *Menegazzia*. Santesson (1942) and Magnusson & Zahlbruckner (1944) characterized these soralia as cuff-like. They are produced on small orbicular outgrowths of the lobes, normally laminal, but occasionally also marginal. Soralia burst open at an early stage showing the sorediate tissue, the upper cortex of the outgrowths curls outwards centrifugally resulting in a duct into the medullary cavity.

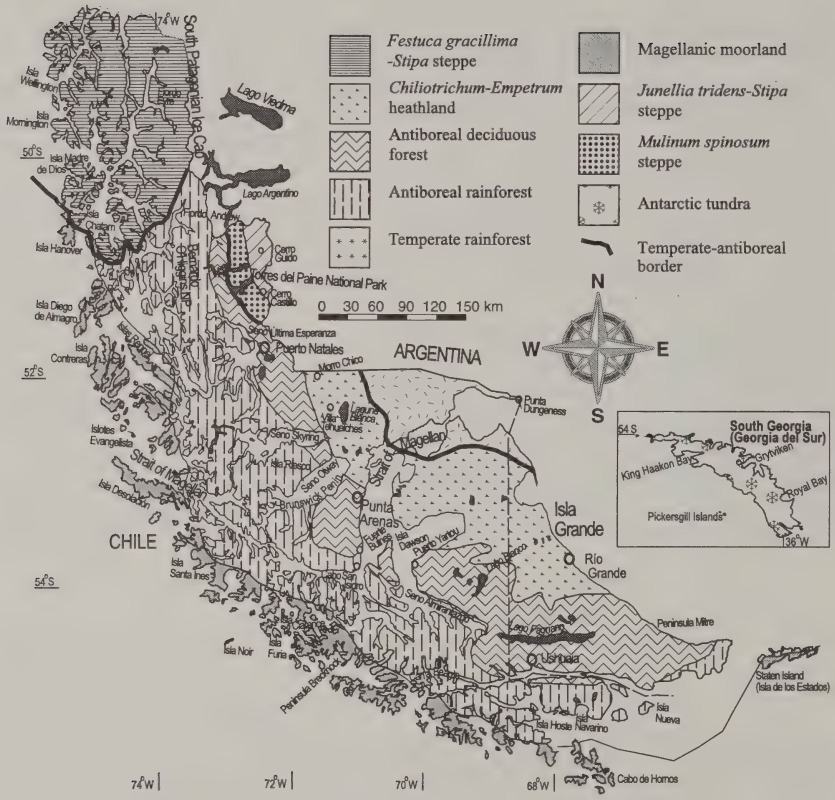
Festuca gracillima -Stipa steppe
Chiliotrichum-Empetrum heathland
Antiboreal deciduous forest
Antiboreal rainforest
Temperate rainforest
Magellanic moorland
Junellia tridens-Stipa steppe
Mulinum spinosum steppe
Antarctic tundra
Temperate-antiboreal border
0 30 60 90 120 150 km
N
W
E
S
74°W
South Patagonian Ice Cap
Lago Viedma
Lago Argentino
Isla Wellington
Isla Mornington
50°S
Isla Madre de Dios
Isla Chatam
Isla Hanover
Fiordo Andrew
Bernardo O'Higgins NP
Cerro Guido
Torres del Paine National Park
Cerro Castillo
Isla Diego de Almagro
Seno Última Esperanza
Puerto Natales
Isla Contreras
52°S
Morro Chico
ARGENTINA
Punta Dungeness
Laguna Blanca
Villa Tehuelches
Islotes Evangelista
Seno Skyring
Strait of Magellan
Isla Riesco
Seno Otway
Isla Desolación
Brunswick Penin.
Punta Arenas
CHILE
Fuerte Bulnes
Isla Dawson
Puerto Yartou
Isla Grande
Río Grande
54°S
Isla Santa Ines
Cabo San Isidro
Seno Almirantazgo
Lago Fagnano
Peninsula Mitre
Isla Noir
Isla Furia
Isla Clarence
Peninsula Brecknock
Ushuaia
Canal Beagle
Staten Island (Isla de los Estados)
Isla Hoste
Isla Navarino
Isla Nueva
Cabo de Hornos
72°W
70°W
68°W
54 S
South Georgia (Georgia del Sur)
King Haakon Bay
Grytviken
Royal Bay
Pickersgill Islands
36°W

Fig. 1: Vegetation zones in southernmost South America according to Elvebakk (in prep.).

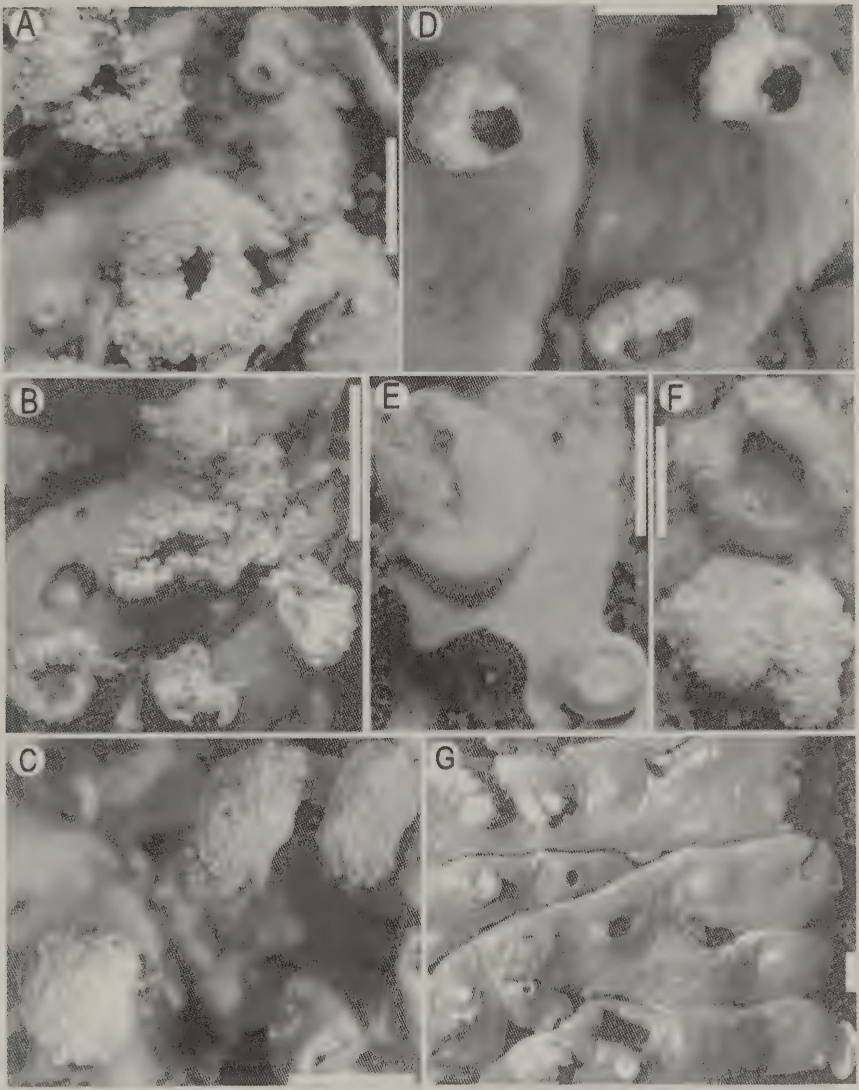

Fig. 2: Soralium types in *Menegazzia*. A. *M. magellanica*, young apothecia seen below the soralia (*A. Elvebakk* 98:058, TROM), B. *M. tenuis* (*H. Imshaug* 50069 & *Ohlsson*, H), C. *M. fumarprotocetrarica* (*W. Quilhot* 2022A, UV), D. *M. neozelandica* (*G. E. & G. Du Rietz* 1014:20a, UPS), E. *M. globulifera*, one young and one old soralium (*A. Elvebakk* 98:064, TROM), F. *M. norsorediata*, soralium associated with apothecium (*W. Quilhot* 12008, UV), G. *M. sanguinascens* (*A. Elvebakk* 98:193a, TROM). See also Figs. 4 and 7. Scale bars = 1.0 mm.

Menegazzia magellanica (Fig. 2A)
Menegazzia neozelandica (see also type 3)
Menegazzia tenuis (Fig. 2B)

2. Pustulate soralia.

Young soralia appear on small laminal pustules. These pustules grow taller and a well-defined sorediate apex is formed. Finally, pustules may burst open exposing an open duct to the cavity. In *M. wandae*, a related species, the pustules are opened by irregular lacerations (Bjerke in press).

Menegazzia fumarprotocetrarica (Fig. 2C)

3. Soralia associated with perforations.

These soralia are restricted to the margins of perforations. The development of the soralia in *M. neozelandica* was illustrated by Beltman (1978).

Menegazzia neozelandica (Fig. 2D)

4. Vesicular (helmet-shaped) soralia.

These soralia arise laminally as small verrucose points similar to young pustules. Subsequently, they obtain a vesicular shape, and open along a split at one end, thus appearing helmet-like.

Menegazzia globulifera (Fig. 2E)

5. Convex, subcapitate to capitate soralia ('soredia apicalia vel subapicalia' *sensu* Du Rietz 1924).

These soralia are produced laminally. At first, they may resemble young maniciform soralia, but later distinctive convex soralia are formed. These may or may not be constricted at base; also intrathalline variation in the degree of constriction was observed in all species belonging to this group. The constriction appears to be age-related, being convex at first, then arising and being wider at the top than at the base, and later when soralia congregate, the constriction is hidden, as in a well-developed champignon that hides its stalk with its hat. Young sorediate pustules of *M. fumarprotocetrarica* may resemble convex soralia.

Menegazzia chrysogaster (Fig. 4)
Menegazzia kawesqarica (Fig. 7A)
Menegazzia norsorediata (Fig. 2F)
Menegazzia sanguinascens (Fig. 2G)

Phytogeography

According to their longitudinal distribution within the study area the species appear to have different distribution patterns. By comparing with the vegetation zones in Fig. 1 the following groups are outlined:

1. Species restricted to Magellanic moorland, antiboreal rainforests and the transition zone to the antiboreal deciduous forests:

Menegazzia chrysogaster
Menegazzia tenuis

2. Species distributed between Magellanic moorland and antiboreal deciduous forests:
   Menegazzia fumarprotocetrarica
   Menegazzia neozelandica
   Menegazzia norsorediata
   Menegazzia sanguinascens

3. Species with a wide distribution, eastwards to *Chiliotrichum-Empetrum* heathland:
   Menegazzia magellanica
   Menegazzia globulifera
   Menegazzia kawesqarica

Caution needs to be exercised for species still poorly collected, especially *M. fumarprotocetrarica*, *M. chrysogaster* and *M. neozelandica*. Magellanic moorland, as a habitat for species of *Menegazzia* in particular, is still imperfectly known.

Chemistry

The stictic acid complex (the stictic acid chemosyndrome by some authors, e.g. Zeybek et al. 1993; Feige & Lumbsch 1995), is very common in *Menegazzia*. In Australian species 70 % (20 of 28 species) contain the stictic acid complex, whereas only a few contain substances from other chemosyndromes (James & Galloway 1992). Atranorin is present in most of these species. For some species all the component stictic acids are reported, viz. stictic, hypostictic, menegazziaic, cryptostictic, and constictic acids, whereas for other species only some of them were reported (James & Galloway 1992).

Four of the nine sorediate species in southernmost South America have the stictic acid agg. as major lichen metabolites, namely *M. chrysogaster* (two unidentified yellow pigments are also present), *M. kawesqarica, M. magellanica* and *M. neozelandica*. The remaining five species are characterized by distinctive lichen substances from different chemosyndromes:

Fumarprotocetraric acid: *Menegazzia fumarprotocetrarica*
Hypothamnolic and thamnolic acids: *Menegazzia sanguinascens*
Lecanoric acid: *Menegazzia globulifera* (+ usnic acid)
Lichesterinic and protolichesterinic acids: *Menegazzia tenuis*
Norstictic acid: *Menegazzia norsorediata*

Atranorin is present in all species except *M. globulifera*. Several other lichen substances were detected in the species studied. In one specimen of *M. kawesqarica* no less than 10 substances were detected, most in trace amounts. No attempt was made to identify all of the lichen substances that are present in minor or trace amounts and normally not detected in all specimens of the particular species. Some or all the unknown substances called Pcr's by Culberson et al. (1981) and White & James (1985) are present in the stictic acid-containing species. In the species treatments below, these substances are included as unidentified substances.

Key to sorediate species of *Menegazzia* in southernmost South America*

*The species *M. wandae* is included in the key, although it is not known from southernmost South America as defined here.

1. Soralia not vesicular in origin; thallus greyish (atranorin). **2.**

1. Soralia derived from ± inflated vesicles or in helmet-shaped extensions of the lobes; thallus yellow-green (usnic acid). *M. globulifera*

2. Soralia not, or only in exceptional cases, associated with perforations; stictic acid chemosyndrome present or absent. **3.**

2. Soralia predominantly associated with perforations; stictic acid chemosyndrome present. *M. neozelandica*

3. Soralia maniciform or derived from pustules, normally showing an open duct to the medullary cavity. **4.**

3. Soralia convex to subcapitate, only rarely with an open duct to the medullary cavity. **7.**

4. Soralia formed on pustules; stictic acid chemosyndrome absent. **5.**

4. Soralia not raised substantially above the upper surface; stictic acid chemosyndrome present or absent. **6.**

5. Lobes without black margins; pustules with a well-defined sorediate apex; fumarprotocetraric acid present. *M. fumarprotocetrarica*

5. Lobes with brown-black margins; pustules lacerate; thamnolic acid present. *M. wandae*

6. Soralia small; few soredia in each soralium; perforations mostly ellipsoid; apothecia not known; protolichesterinic and lichesterinic acids present. *M. tenuis*

6. Soralia variable; soredia numerous; perforations ± circular; occasionally fertile; stictic acid complex present. *M. magellanica*

7. Upper side of cavity white or brown-black, with or without orange patches; UV- or UV+ sky blue. **8.**

7. Upper side of internal cavity yellow or ochre; UV+ pale orange. *M. chrysogaster*

8. Lobes greyish, slightly to prominently maculate, subdichotomously to irregularly ramified; soralia often confluent; soralia and medulla UV-. **9.**

8. Lobes grey to salad-green on dry, fresh material, emaculate, sympodially branched; soralia seldom confluent; soralia and medulla UV+ sky blue (hypothamnolic acid). *M. sanguinascens*

9. Lobes only slightly maculate; soralia and medulla occasionally with orange patches (norstictic acid). *M. norsorediata*

9. Lobes effigurate-maculate; soralia never with orange patches; stictic acid complex present. *M. kawesqarica*

The species

Menegazzia chrysogaster Bjerke & Elvebakk sp. nov. Fig. 3

Menegazziae caliginosae similis, sed lobis contiguis, foraminibus numerosis. Thallus pigmenta diversa aurantiaco-lutea ignota continens, sine acidis echinocarpico et norstictico, et sine apotheciis maturis.

Type: Chile, Region IX, Provincia de Malalcahuello, Malleco, 12 October 1987, *W. Quilhot* 2004 (S—holotype; UV—isotype). [TLC (JWB 05/2000): stictic (major), constictic (major) and cryptostictic (minor) acids, atranorin (major), two unidentified yellow pigments (UV+ pale orange)].

Thallus corticolous, closely appressed, lobe tips loosely attached, to 12 cm diam. *Lobes* flat to slightly convex, contiguous to margins, imbricate towards centre, irregularly to subdichotomously branched, inflated, outer lobes 1.2 to 3.0 mm wide. *Upper surface* grey, at centre slightly blackened, smooth, emaculate or rarely slightly maculate (x10 lens), epruinose or slightly pruinose at the lobe apices, glossy towards lobe apices, faintly corrugate towards centre; apices pale brown, occasionally with non-perforate crater-like depressions; depressions 0.4-0.6 mm deep, 1.0-1.5 mm wide; sorediate. *Perforations* numerous, circular to ellipsoid, normally 0.4-0.9 mm wide, occasionally to 1.9 mm wide, especially in the area where the lobes divide, margins not elevated. *Soralia* numerous, laminal, scattered or occasionally clustered, most common centrally, convex to subcapitate, to 1.2 mm diam., not associated with perforations; occasionally associated with crater-like depressions in the upper surface; soredia finely granular, white, often with ochre-yellow patches. *Lower surface* black, brown towards lobe apices, nitid, wrinkled. *Cavity* ochre-yellow on both upper and lower sides, tomentose towards lobe ends, blackened centrally; medulla white between photobiont layer and the yellow upper side of the cavity. *Apothecia* very rare, subpedicellate, to 0.9 mm wide; disc concave, hardly visible, brown; exciple thick, esorediate. *Asci* immature, without ascospores. *Pycnidia* not seen.

Chemistry: Atranorin (major to minor), stictic acid (major), cryptostictic acid (minor), constictic acid (major), one unidentified colourless substance in upper cortex (minor to absent), two unidentified yellow-orange pigments in the upper and lower sides of the cavity (both minor). Data for both pigments: K+ pale orange, UV_{366}+ pale orange before charring (both in thallus and on TLC plates), solvent A: R_f class 3, solvent C: R_f class 2, UV- after charring. The distance between the two pigments is 3-4 mm in both solvents. Data for the colourless substance: UV_{366}+ sky blue before charring (on TLC plates), solvent A: R_f class 7, solvent C: R_f class 7 (partly obscuring atranorin), hardly visible after charring.

M. chrysogaster is distinguished by its pigmented sides of central cavity that does not contain echinocarpic acid, by its convex soralia, and by its glossy lobes that are only sporadically slightly maculate or pruinose.

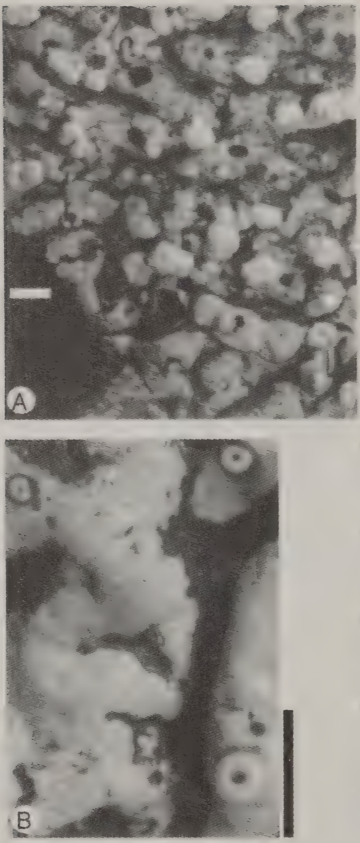

Fig. 3: *Menegazzia chrysogaster*. A. Thallus with subcapitate soralia. B. Detail showing immature apothecia. *W. Quilhot* 2004. Scale bar = 1 mm.

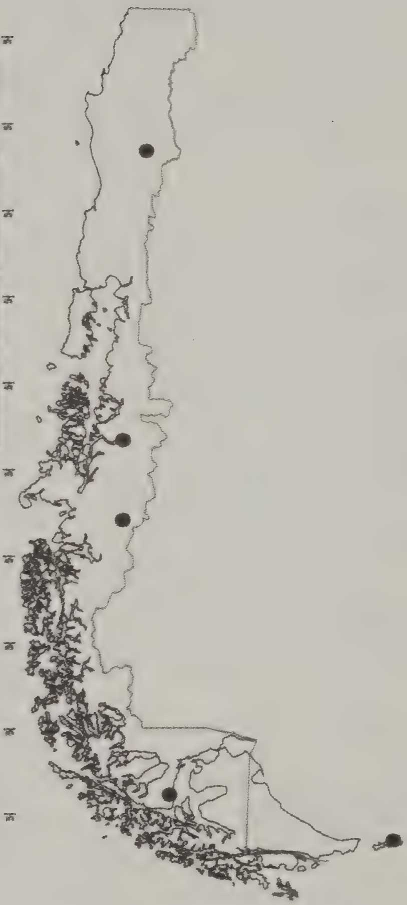

Fig. 4: Total distribution of *Menegazzia chrysogaster.*

Variation: *M. chrysogaster* has a rather constant chemistry, but shows some morphological variation. The specimen from Isla de los Estados is distinguished from the more northerly populations by having scattered crater-like depressions in the upper cortex. Soralia are produced both laminally and at the margins of the depressions. The soralia are also smaller in the specimen from Isla de los Estados. A specimen from Region XI (*W. Quilhot* 1808) is somewhat corrugate towards centre and slightly maculate. A few very young, minute apothecia were seen in one individual (the type specimen), but neither asci nor ascospores were seen (for discussion, see below *M. kawesqarica*).

Ecology and distribution: *M. chrysogaster* is known from Provincia de Malleco (Reserva Nacional de Malalcahuello) at lat. 39° S in Region IX of Chile and southwards to Isla de los Estados, Argentina, at lat. 54° 45' S (Fig. 5). Little is known about its ecological requirements, but it may prefer rather luxuriant, humid forests, such as the antiboreal and temperate rainforests. The specimen from Brunswick Peninsula (*R. Santesson* 8076) was collected from *Nothofagus betuloides*. According to the attached label, the specimen from Isla de los Estados (*H. Imshaug* 51684 & *K. Ohlsson*) was collected from *Dracophyllum* sp., an *Epacridaceae* genus not known from South America, and may be referable to its southern South American representative, the dwarf shrub *Lebetanthus myrsinites*.

Discussion: *M. chrysogaster* shares several characters with the Australian species *M. caliginosa* P. James & D. J. Galloway (Galloway 1983; James & Galloway 1992). The upper side of the internal cavity in both species is yellow to ochre-yellow, and both have scattered, convex soralia and a glossy upper surface. In addition, stictic acid and accessory compounds are present in both species. However, chemical analyses revealed that different pigments caused the yellow colour of the upper side of the cavity. Echinocarpic acid, a common substance in *M. caliginosa*, was not detected in *M. chrysogaster*. The yellow hyphae in *M. caliginosa* contained five pigments, all with higher R_f values in solvent C than the two pigments in *M. chrysogaster*. Although the identity of these pigments remains unidentified, there is no doubt that *M. caliginosa* and *M. chrysogaster* are chemically distinct. There are also some important morphological differences between the two species; the wide-angled marginal lobes and the large, fertile apothecia are unique for *M. caliginosa*.

M. chrysogaster is the only species in southern South America with a yellow medulla. In other respects it may resemble some of the other species with convex to subcapitate soralia. It is distinguished from *M. norsorediata* by the glossy, emaculate upper surface, and the scattered soralia that are rarely confluent. *Menegazzia sanguinascens* is distinct due to its toe-like lateral lobes, and its greenish upper surface in fresh material. They are also chemically distinct. For a comparison with *M. kawesqarica*, see under the latter species.

The two specimens from Isla Desolación published by Santesson (1942) as *M. sanguinascens* (16 April 1896, *P. Dusén* s.n. [two collections], S) are rather similar to *M. chrysogaster*. They are glossy in parts, contain the stictic acid syndrome, but they lack the yellow pigments present in *M. chrysogaster*. These two specimens should be compared with material from Central Chile and from the most oceanic parts of the Magellanic Archipelago before a conclusion about their taxonomic status is reached.

Etymology: The epithet '*chrysogaster*' refers to the ochre-yellow cavity (the 'gaster'), which is a diagnostic character in the species.

Additional specimens examined: CHILE: REGION XI: Provincia de Aisén: Lago Riesco, 22 November 1993, *W. Quilhot* 1813 (UV); Provincia de Aisén, Carretera Austral, November 1993, *W. Quilhot* 1808 (UV). REGION XII: Provincia de Magallanes: Punta Arenas, Tres Puentes, 24 April 1940, *R. Santesson* 8076 (S). ARGENTINA: PROVINCIA DE TIERRA DEL FUEGO: Isla de los Estados: Puerto Cook, 24 October 1971, *H. Imshaug* 51684 & *K. Ohlsson* (O).

Menegazzia fumarprotocetrarica Calvelo & Adler, Mycotaxon 59: *369* (1996)

Type: Argentina: Prov. de Río Negro, Bariloche, Llao Llao, 7 October 1993, S. Calvelo 37861 (BAFC, holotype).

This recently described species was previously reported only from a restricted area in Provincia de Río Negro in Argentina where it grows on *Nothofagus dombeyi* (Adler & Calvelo 1996). Except for a general report in the checklist of Chilean lichens (Galloway & Quilhot 1999), it has not been cited from Chile.

Remarks: *Menegazzia fumarprotocetrarica* is characterized by soralia that are formed on large protuberances (pustules), small, irregularly inflated lobes and the presence of fumarprotocetraric acid. The raised soralia are closed at first, but later, they may open and reveal a narrow duct to the cavity. The only variation observed is in the soralia, which occasionally burst open showing an open duct to the medullary cavity.

Chemistry: Atranorin (major) and fumarprotocetraric acid (major), norstictic acid (trace) and two unidentified trace substances.

Ecology and distribution: From the Magellanic Region it was observed only in *Nothofagus antarctica* swamp forests near Laguna El Parrillar associated with several other species of *Menegazzia*. It was not seen in *N. betuloides* forests along the coast, nor in *N. pumilio* forests more inland. However, the individual from Isla Grande was collected from *N. betuloides*. The only two known collections are from a narrow section in the transition zone between *N. betuloides* evergreen forest and deciduous forests (Fig. 5).

Specimens examined: CHILE: REGION XII: Provincia de Magallanes: Laguna El Parrillar, 40 km SW of Punta Arenas, 26 November 1999, *A. Elvebakk* 99:744B (TROM), 99:745A (TROM, S, H), 99:753A (HO). ARGENTINA: PROVINCIA TIERRA DEL FUEGO: Isla Grande: Tierra del Fuego National Park, Cascada Río Pipo, 8 January 1989, M. Wedin 1075 [admixture] (UPS).

(The specimen photographed in Fig. 2C, *W. Quilhot* 2022A (UV), is from Region IX.)

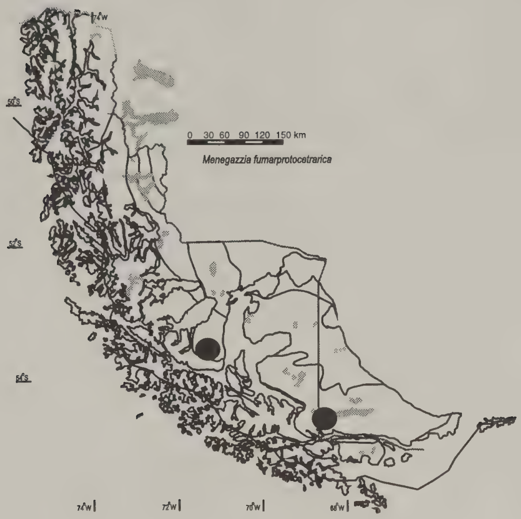
74°W
50°S
0 30 60 90 120 150 km
Menegazzia fumarprotocetrarica
52°S
54°S
74°W
72°W
70°W
68°W

Fig. 5: Distribution of *Menegazzia fumarprotocetrarica.*

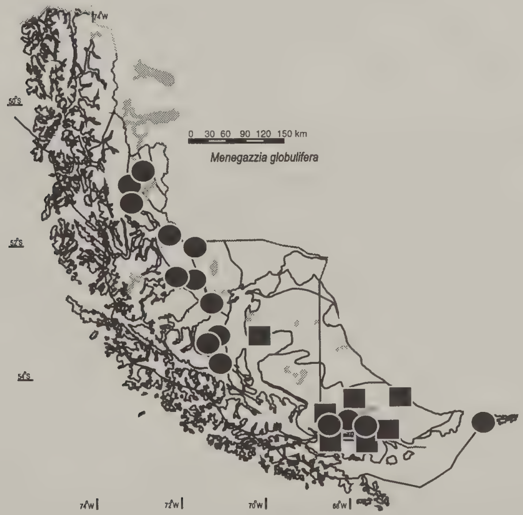
74°W
50°S
0 30 60 90 120 150 km
Menegazzia globulifera
52°S
54°S
74°W
72°W
70°W
68°W

Fig. 6: Distribution of *Menegazzia globulifera.* ● = Examined collections, ■ = Non-examined published reports.

Menegazzia globulifera R. Sant., Ark. Bot. 30A (11): *25* (1942).

Type: Argentina: Tierra del Fuego, Puesto Millaldeo, N of Lago Fagnano, 16 January 1929, H. Roivainen (S, holotype).

This is the best-known sorediate species of *Menegazzia* from the Southern Hemisphere. It has a panaustral distribution, and is described in detail by several authors (Santesson 1942, Galloway 1985, James & Galloway 1992, Calvelo & Adler 1994).

Remarks: *M. globulifera* is characterized by the helmet-shaped, vesicular soralia and the yellow-green thallus caused by the accumulation of usnic acid in the upper cortex. Due to its distinctive characters, it is easy to recognize although it may show some variation in lobe width and the shape of the soralia, which in the last stage are totally open. The yellow-green colour is less prominent on old herbarium specimens.

Chemistry: Usnic acid and lecanoric acid (both major). The stictic and norstictic acids reported by Quilhot et al. (1975) were not detected in the analyzed specimens.

Ecology and distribution: *M. globulifera* has the widest longitudinal distribution of any species of *Menegazzia* in the Magellanic Region ranging from *Chiliotrichum-Empetrum* heathland westwards to Magellanic moorland (Fig. 6). It is common in high-light situations and is also found on rocks. The tolerance to high levels of incident radiation is probably mitigated by usnic acid, which serves as protection against UV-B radiation (Quilhot et al. 1998). In shaded habitats the yellow-green colour of the thallus is not so prominent as in high-light situations, because the need for UV-B protection is less here than in exposed habitats. In the Magellanic Region it has its optimal abundance in *Nothofagus pumilio* forests.

Selected specimens examined (total 29): CHILE: REGION XII: Provincia de Última Esperanza: Torres del Paine National Park, Lago Pehoe NW, 500 m SE of Camping Pehoe, 6 January 1998, *A. Elvebakk* 98:064 (TROM). Provincia de Magallanes: Seno Otway, 2 km NE of Punta Espolón, 30 November 1999, *A. Elvebakk* 99:927; Seno Skyring N, 3 km W of Pto. Alomirano, 30 November 1999, *A. Elvebakk* 99:958 (TROM); Punta Arenas W, Río de las Minas, 12 March 1992, *A. Elvebakk* 92:002 (TROM). ARGENTINA: PROVINCIA DE TIERRA DEL FUEGO: Isla Grande: Ushuaia, 1984, *T. Engelskjøn* s.n. (BG). Isla de los Estados: Bahía Crossley, 18 October 1971, *H. Imshaug* 50852 & *K. Ohlsson* [admixed with and labelled *M. magellanica*] (H).

Menegazzia kawesqarica Bjerke & Elvebakk sp. nov. Fig. 7

Species cum thallo et substantiis ut in *Menegazzia subpertusa* sed ab hac specie differt superficie maculata et absentia apotheciorum maturorum.

Type: Chile, Region XII, Provincia de Magallanes, Morro Chico, in the central depression of the volcanic rock outcrop, 52°03'S - 71°28'W, on a vertical southfacing cliff surface, 220 m alt, 28 November 1999, *A. Elvebakk* 99:875 (S—holotype; HO, TROM, UV—isotypes). [TLC (JWB 1999): stictic (major), constictic (major) and cryptostictic (minor) acids, atranorin (major)].

Thallus corticolous and saxicolous, often overgrowing small bryophytes and other lichens, adnate, to 10 cm in diam. *Lobes* convex, contiguous to margins, subdichotomously branched, continuously inflated, 1.0 to 2.0, rarely to 2.7 mm wide, occasionally with short lateral branches. *Upper surface* grey or greyish green, centrally, patchily blackened, undulating, corrugate or rugose, less corrugate towards the lobe apices, reticulately maculate, dull, rarely slightly glossy towards the lobe apices; apices with brownish-black margins, often slightly pruinose; sorediate. *Perforations* frequent, circular to ellipsoid, to 1.5 mm diam., margins not elevated. *Soralia* numerous, to 1.2 mm diam. before coalescing, laminal, convex to subcapitate at first, later coalescing and spreading over the upper surface, rarely associated with perforations; soredia granular, white to pale yellow, occasionally with some brown-black granules. *Lower surface* jet black, slightly shiny, pleated. *Cavity* white above, brown-black below. *Apothecia* very rare, subpedicellate, to 1.1 mm wide; apothecial disc concave, light to dark brown; exciple cracked, sorediate. *Hymenium* pale brown; asci only observed as immature/sterile, 30-65 x 20-40 µm. *Ascospores* not seen, an initial bipartite division of the ascoplasm seen in a few asci. *Pycnidia* rare, normally co-occurring with apothecia, numerous when present, regularly distributed to clustered. *Conidia* 5-8 x 0.5 µm.

Chemistry: Atranorin (major to minor), stictic acid (major), cryptostictic acid (minor), constictic acid (major), menegazziaic acid (trace to absent), norstictic acid (rarely faint traces), traces of unidentified satellite compounds.

M. kawesqarica is distinguished by its subcapitate, confluent soralia and by its convex, corrugate, maculate and pruinose lobes.

Variation: *M. kawesqarica* has a rather constant chemistry and morphology. The width of the lobes may vary, but they are seldom wider than 2 mm. A few specimens were seen with apothecia that did not produce mature asci and ascospores. Most of the apothecia were minute, but the largest were of such size that one would normally expect to find mature asci, but also in these apothecia the ascoplasm was underdeveloped (Fig. 7C). This is considered as a remnant of sexual reproduction from a fertile ancestor, but suppressed in the present species with a vegetative reproduction strategy. A similar interpretation was also made regarding the low frequency of ascomata in *Bryoria* (Brodo & Hawksworth 1977; Hawksworth & Hill 1984). The same type of suppression may be present in *M. chrysogaster*. Nevertheless, the observed initial bipartite division of the ascoplasm in a very few asci of *M. kawesqarica* may indicate that this species belongs to the subgenus *Dispora*.

Ecology and distribution: *M. kawesqarica* is presently known from Cochrane at lat. 47° S in Region XI of Chile and southwards to Isla Grande (Fig. 8). It has an eastern distribution pattern, being most common in the driest part of antiboreal deciduous forests, and also being distributed east of the forest zones. Thus, the holotype is from Morro

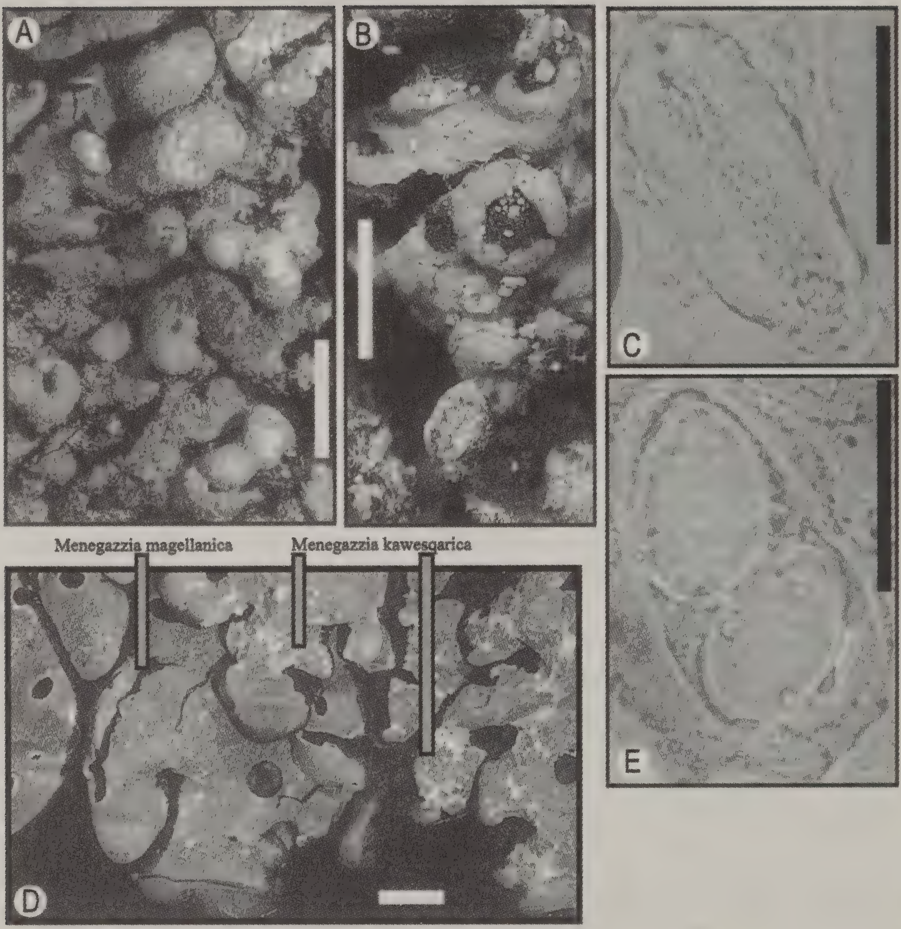

Fig. 7: *Menegazzia kawesqarica* and *M. magellanica*. A. Thallus of *M. kawesqarica* with subcapitate soralia, B. Immature apothecium of *M. kawesqarica* with a capitate soralium below, C. Ascus of *M. kawesqarica* with an undifferentiated ascoplasm, D. Admixture of *M. kawesqarica* (reticulate-effigurate maculate lobes) and *M. magellanica* (patchily and only slightly maculate lobes), E. Mature, two-spored ascus of *M. magellanica*. A and B: *A. Elvebakk* 96:181 (TROM), C: *A. Elvebakk* 99: 746A (TROM), D: *A. Elvebakk* 96:216 (TROM), E: *A. Elvebakk* 99:744A (TROM). Scale bars, A, B and D = 1 mm; C and E = 50 μm.

Chico, a volcanic rock situated in relatively dry *Chiliotrichum-Empetrum* heathland, but here in a strongly shaded and protected saxicolous habitat. It is regularly found to be both saxicolous and corticolous. In Chorrillo de Salmones, the most luxuriant part of Torres del Paine National Park, it is common on trunks and branches of *Nothofagus pumilio*. In less humid areas near Río Pingo in the same park it is most frequent on south-facing rock surfaces. At Brunswick Peninsula it is rather common in *N. antarctica* swamp forest. It was also collected from thin trunks and branches of *Maytenus magellanica*.

Discussion: Morphologically, *M. kawesqarica* is most similar to *M. chrysogaster, M. norsorediata* and *M. sanguinascens* among the other South American species, because of the subcapitate form of the soralia. *M. kawesqarica* is distinguished from *M. sanguinascens* by the corrugate, maculate upper surface, the colour of fresh material, and the more confluent soralia, in addition to being chemically very distinct. *M. norsorediata* may also be both maculate and corrugate, but the lobe apices are glossy, occasionally also in older lobes, and the lobe apices are not pruinose as they occasionally are in *M. kawesqarica*. In addition, the two species are chemically different. *M. kawesqarica* is distinguished from *M. chrysogaster* by the confluent soralia, and the maculate upper surface, in addition to the white medulla.

The common presence of the stictic acid complex has lead to the separation of several Australian species solely on morphological characters, occasionally with some supplementary minor chemical differences (Galloway 1985, James & Galloway 1992). The Australasian species morphologically and chemically most similar to *M. kawesqarica* is *M. subpertusa* P. James & D. J. Galloway. This latter species is distinguished from *M. kawesqarica* by the larger thallus, the emaculate lobes, the presence of mature apothecia, and a different type of thallus branching. In other respects, the two species are quite similar; both having pruinose, corrugate lobes and convex to capitate laminar soralia, being both epiphytic and saxicolous, and having a similar chemistry.

In studies on species of *Hypogymnia* (Zeybek et al. 1993; Feige & Lumbsch 1995) it was concluded that differences in the presence or absence of some minor compounds within a chemosyndrome were constant, and even interspecific constant differences in concentrations of some compounds were observed. A similar situation was observed when comparing *M. kawesqarica* with *M. magellanica* and *M. neozelandica*. Menegazziaic acid was normally absent in *M. kawesqarica* and present in the other two species, but some samples of *M. kawesqarica* had traceable amounts of menegazziaic acid, whereas in some samples of *M. magellanica* this substance was not detected or it was only present as faint traces. In *M. neozelandica* menegazziaic acid appears to be constant. The major distinguishing features between these three species are, nevertheless, morphological. The most striking difference is the form of the soralia, being cuff-like or maniciform (*sensu* Du Rietz 1924) in *M. magellanica*, being closely associated with perforations in *M. neozelandica*, and being subcapitate and partly confluent in *M. kawesqarica*.

In the field we first thought we could demonstrate intermediate forms between *M. magellanica* and *M. kawesqarica* where some individuals contained both types of soralia. However, in the laboratory it was seen that the two types of soralia were on different individuals that had overlapping lobes, as shown in Fig. 7D. The effigurate maculation and the more corrugated upper surface of *M. kawesqarica* served as well-defined features to distinguish them from each other, in addition to the type of soralia. In the laboratory the non-elevated margins of the perforations of *M. kawesqarica* were found to support distinguishing intermixed lobes of the two species. The relationship between *M. kawesqarica* and *M. neozelandica* appears to be more distant than between the former and *M. magellanica*. In addition to minor chemical differences, morphological differences are prominent. The soralia are very different between *M. kawesqarica* and *M. neozelandica*, the upper surface is glossy and the perforations are smaller in *M. neozelandica*.

Etymology: *M. kawesqarica* is named from the indigenous people *Kawesqar* who inhabited the coastal area in southwestern Patagonia. These people were also called *alacalufes* by early Spanish-speaking settlers (Aguilera & Eltit 1996). The spelling is adopted from the same source.

Additional specimens examined: CHILE: REGION XI: Provincia de Capitán Prat: Cochrane National Reserve, 19 November 1993, *W. Quilhot* 1376 (UV, TROM). REGION XII: Provincia de Última Esperanza: Torres del Paine National Park, Chorrillo de Salmones, 30 January 1996, *A. Elvebakk* 96:180, 96:181, 96:215, 96:216 [admixture] (TROM); Torres del Paine National Park, 1-1.5 km WNW of Guardería Lago Grey, 4 December 1999, *A. Elvebakk* 99:1068 (TROM), 99:1090 (BAFC); Torres del Paine National Park, 0.5 km N of Chorrillo de Salmones, 26 February 1998, *J. W. Bjerke* 011/98 (TROM). Provincia de Magallanes: Morro Chico, 28 November 1999, *A. Elvebakk* 99:821B (TROM); Laguna El Parrillar, 40 km SW of Punta Arenas, 26 November 1999, *A. Elvebakk* 99:746A, 99:754 (TROM); Punta Arenas, 21 November 1895, *P. Dusén* 4a [admixture] (S). Provincia de Tierra del Fuego: Isla Grande, Canal Whiteside, Puerto Yartou, 12 February 1941, *R. Santesson* 6100 (S).

Menegazzia magellanica R. Sant. Ark. Bot. 30A (11): *21* (1942).

Type: Chile: Punta Arenas, 1896, P. Dusén 4b (S, holotype).

[Note: For the present study P. Dusén's collections 4a and 4c from Punta Arenas were available. Santesson (1942) identified these two collections together with P. Dusén 4b (the holotype) as *M. magellanica*. Collection 4a consists of four specimens attached to a sheet. Three of these individuals are here redetermined as *M. kawesqarica*, whereas the last individual is *M. sanguinascens*. Collection 4c, comprising two specimens, is in its entirety *M. sanguinascens*.]

Menegazzia magellanica is one of the most abundant species of the genus in antiboreal *Nothofagus* forests. Some of the recently described species are rather similar to *M. magellanica* and were previously included, at least in part, within the intraspecific variation of *M. magellanica*. Descriptions of *M. magellanica* in Santesson (1942) and Calvelo & Adler (1994) are, nevertheless, in accordance with the concept presented here.

Remarks: *M. magellanica* is characterized by maniciform soralia, containing numerous soredia that at an early stage burst open to produce a duct to the cavity, a smooth upper surface, which is only sparingly rugulose centrally and finely maculate at lobe apices (Fig. 7D), and the presence of the stictic acid chemosyndrome. It is occasionally fertile, having well-developed apothecia with a sorediate exciple. The asci are two-spored (Fig. 7E). A few specimens with maniciform soralia had broadly convex, glossy lobes with toe-like lateral branches, and only trace amounts of atranorin, or else this compound was not found

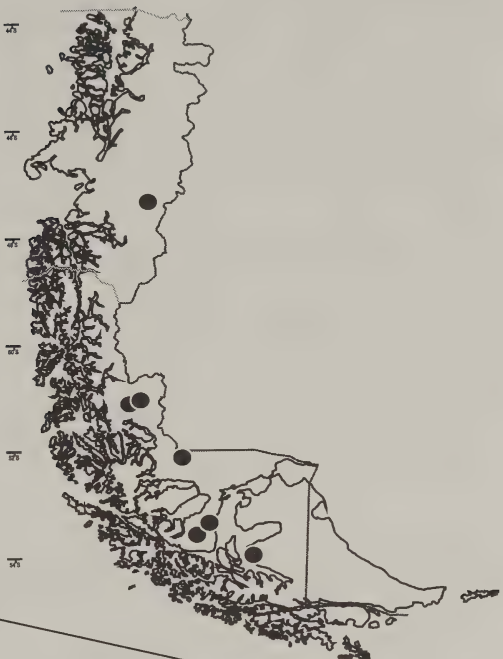
44°S
46°S
48°S
50°S
52°S
54°S

Fig. 8: Total distribution of *Menegazzia kawesqarica*

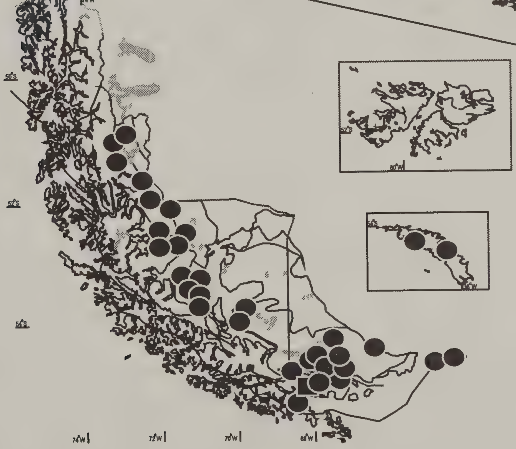
50°S
52°S
54°S
74°W
72°W
70°W
68°W
52°S
60°W
54°S

Fig. 9: Distribution of *Menegazzia magellanica.*

at all (e.g. *A. Elvebakk* 98:255, TROM). In addition, the unidentified colourless substance (UV+ sky blue) reported from *M. chrysogaster* was detected in some specimens with a deviating morphology. This group of specimens may represent a separate taxon, but the number of specimens studied was not sufficient to draw any conclusions.

The size of the lobes and soralia vary with habitat type, Lobes are broad and radiating in specimens from luxuriant *Nothofagus betuloides* forests, whereas towards the heathlands the growth of individuals appears to be more stunted. A very compact growth form was also observed on specimens from South Georgia. The duct through the maniciform soralia is occasionally not open, particularly in exposed habitats.

Chemistry: On the basis of material from Region X, Quilhot et al. (1975) reported atranorin, lecanoric, stictic, salazinic, and norstictic acids from *M. magellanica*. Calvelo & Adler (1994) reported atranorin, stictic and constictic acids. During the present study the following substances were detected: atranorin (major to trace), stictic (major), norstictic (faint trace to absent), constictic (major), cryptostictic (minor), and menegazziaic acids (minor). In addition, the two satellite compounds Pcr-1 and Pcr-2, reported by Culberson et al. (1981) from *M. terebrata* (Hoffm.) Massal., were detected (both minor). Lecanoric and salazinic acids were not detected. An unidentified substance (UV+ sky blue; R_f class 7) was present in a few specimens.

Ecology and distribution: *M. magellanica* is present in all vegetation zones, except for the driest *Junellia tridens-Stipa* and *Festuca gracillima-Stipa* steppes (Fig. 9). It is the only species of *Menegazzia* occurring in South Georgia. Thus, it is the only species of *Menegazzia* known from any of the South Atlantic islands.

M. magellanica is a prominent epiphyte of both trunks and twigs, especially of tall trees of *Nothofagus*, but it is also scattered on smaller bushes, such as *Berberis* spp., *Embothrium coccineum* and *Chiliotrichum diffusum*. It has a wide amplitude from open *Chiliotrichum-Empetrum* heathland to medium shade close to the forest floor in well-developed mixed *Nothofagus betuloides-pumilio* forests where it reaches its highest abundance.

Discussion: *M. magellanica* is distinguished from *M. tenuis* by the width of the lobes, the nature and size of the soralia, and different chemistry. *M. fumarprotocetrarica* and *M. wandae* may also show an open duct to the cavity, but these are formed on pustules, and further these two species are chemically very distinct from *M. magellanica*. The mostly laminar soralia of *M. magellanica* and the soralia associated with the perforations in *M. neozelandica* are considered the distinguishing feature between these two species (Santesson 1942; Calvelo & Adler 1994). However, several of the specimens of *M. magellanica* examined during the present study have some soralia associated with perforations. In addition, one of the examined collections of *M. neozelandica* (*Tibell* 10696, H, S) has several soralia not associated with perforations. When not associated with perforations the soralia are of the same type as in *M. magellanica*. These two species also have a similar chemistry, although atranorin, stictic, norstictic and menegazziaic acids appear to be present in higher concentrations in *M. neozelandica*. Several morphological characters are, however, distinct between these two species, e.g. the upper surface being smooth and glossy in *M. neozelandica*, whereas in *M. magellanica* it is occasionally smooth in parts, but rarely glossy. They also belong to different subgenera, *M.*

magellanica having eight spores in the asci, *M. neozelandica* two. Thus, these two species are rather well-separated from each other, typical specimens being very distinct, although some extreme forms may approach the other species in morphology.

Selected specimens examined (total 90): CHILE: REGION XII: Provincia de Última Esperanza: Torres del Paine National Park, 500 m SE of Camping Pehoe, 6 January 1998, *A. Elvebakk* 98:058 (TROM); Torres del Paine National Park, Refugio Zapata, 28 February 1998, *A. Elvebakk* 98:255 (TROM). Provincia de Magallanes: 9.3 km N of Villa Tehuelches, 18 March 1998, *J. W. Bjerke* 215/98 (TROM); Seno Otway, Bahía Camden, 20 December 1967, *H. Imshaug* 39121, 39145 & *R. Harris* (H); Seno Skyring N, 3 km W of Pto. Almirano, 30 November 1999, *A. Elvebakk* 99:975B, 99:981 (TROM); Punta Arenas W, Río de las Minas, March 1992, *A. Elvebakk* 92:001, 92:069, 92:074 (TROM); Laguna El Parrillar, 26 December 1975, *O. Dollenz* 482 (HIP); Laguna El Parrillar, 26 November 1999, *A. Elvebakk* 99:744A (TROM); Fuerte Bulnes, Puerto del Hambre, Punta Santa Ana, 17 December 1967, *H. Imshaug* 38730 & *R. Harris* (H). Provincia de Tierra del Fuego: Isla Grande, Río Bueno, 28 April 1994, *E. Pisano & E. Domínguez* 7017 (HIP). Provincia de Antárctica Chilena: Isla Hoste, 'Tekenikaviken' [Bahía Tekenika], 6 November 1902, *C. Skottsberg* 20 [XX] (S); Isla Navarino, 4 March 1902, *C. Skottsberg* 10 [X], *s.n.* [2 specimens], (S); Isla Navarino, Puerto Toro, October 1975, *W. Quilhot* 1804 (UV). ARGENTINA: PROVINCIA DE TIERRA DEL FUEGO: Isla Grande: Tierra del Fuego National Park, E shore of Lago Roca, 7 January 1989, *M. Wedin* 1054 (UPS); Ushuaia, 6 March 1902, *C. Skottsberg s.n.* (S); Laguna Escondida, Hostería Petrel, 22 November 1971, *H. Imshaug* 54625, 54633, 54653, 54688 & *K. Ohlsson* (H); Monte Olivia, Sierra Sorondo, 28 November 1971, *H. Imshaug* 55616 & *K. Ohlsson* (S); Harberton, 29 October 1902, *C. Skottsberg* 30 [XXX] (S); Estancia Moat, 2 km E of Pampa de los Indios, 12 January 1989, *T. Ahti* 48976b (H); Río Irigoyen, c. 1 km from the seashore, 31 January 1987, *S. Stenroos* 2715 p.p. (H); Estancia Dos Hermanas, 6 January 1989, *T. Ahti* 48142 (H). Isla de los Estados: Bahía Crossley, 18 October 1971, *H. Imshaug* 50745, 50852 & *K. Ohlsson* (H); Puerto Vancouver, 23-28 October 1971, *H. Imshaug* 51502, 51523, 52104, 52120 & *K. Ohlsson* (H). SOUTH GEORGIA: Elephant Cove, 3 January 1971, *R. Smith* 1611 (AAS); Promontory on south side of Nunéz Peninsula, 30 December 1970, *R. Smith* 1605 (AAS).

Menegazzia neozelandica (Zahlbr.) P. James, Fl. Australia 54: *313* (1992).

Type: New Zealand: Wellington, J. Buchanan (BM, holotype).

This austral species, recognized by its sorediate perforations, was reported from two localities in the Argentinean part of Isla Grande (Calvelo & Adler 1994). It was also included in the Chilean checklist (Galloway & Quilhot 1999).

Four specimens from UV previously identified as *M. neozelandica*, but not published, were studied. Only one of these identifications was confirmed here. The remaining ones were redetermined to *M. wandae* (*W. Quilhot* 1440, 1821; see Bjerke in press) and *M. kawesqarica* (*W. Quilhot* 1376). We also found one specimen of *M. neozelandica* admixed with three other species of *Menegazzia* in one of Santesson's collections. For discussion, see under *M. kawesqarica* and *M. magellanica*.

Chemistry: Atranorin, stictic, constictic, and menegazziaic acids were reported both by James & Galloway (1992) and by Calvelo & Adler (1994). The former account also reported norstictic acid (trace) and accessory compounds. In addition to the substances reported by James & Galloway (1992) cryptostictic and several unidentified substances in minor concentrations were detected here.

Ecology and distribution: It is a very rare species in South America known only from four localities, the two reported by Calvelo & Adler (1994) and the two from Chile reported here (Fig. 10). Although searched for, it was not found by the present authors in the Magellanic Region. It appears to be restricted to mixed *Nothofagus* forests, but its habitat ecology here is imperfectly known.

Specimens examined: CHILE: REGION XI: Provincia de Aisén: Lago Riesco, 22 November 1993, *W. Quilhot* 1374 (UV). REGION XII: Provincia de Magallanes: Isla Riesco, Mina Elena, 29 April 1940, *R. Santesson* 7815 [Admixture] (S). NEW ZEALAND: Otahua, Pihanga, 1874, *S. Berggren s.n.* (S); North Island, York Bay (near Wellington), 7 December 1926, G. *E. & G. Du Rietz* 1014:20a (UPS); South Island, Marlborough, 4 February 1981, *L. Tibell* 10696 [exsiccatae] (H, S).

Menegazzia norsorediata Adler & Calvelo, Mycotaxon 59: *368* (1996).

Type: Argentina: Prov. de Tierra del Fuego, 10 km from the intersection of Moat River and the route from Moat to Ushuaia, November 1993, S. Calvelo & M. Adler (BAFC 37732, holotype).

This species was previously reported only from the Río Negro and Tierra del Fuego Provinces in Argentina (Adler & Calvelo 1996), in addition to a general report from Chile by Galloway & Quilhot (1999).

Remarks: The convex to subcapitate soralia and the presence of norstictic acid that often is visible as orange patches in the medulla and soralia, are the most prominent distinguishing features of this recently described species. Adler & Calvelo (1996) did not observe any apothecia. A single specimen from Region IX (*Quilhot* 12008, UV) was found to be fertile, as described below: Apothecia rare (not found in material from southernmost South America), 1-2 mm wide, subpedicellate; disc concave, epruinose, slightly shining, brown; exciple crenulate and sorediate, concolourous with thallus. Ascospores 2 per ascus, ovoid-ellipsoid, 40-55 x 22-35 μm; wall 4-5 μm thick. The small number of specimens seen show little in the way of morphological variation. Apothecia and pycnidia are rare. The lobe width shows some small variation, in addition to the maculation, which also show some intrathalline variability.

Chemistry: Atranorin (major to trace), norstictic acid (major), stictic acid (normally absent, but trace to minor amounts in three specimens).

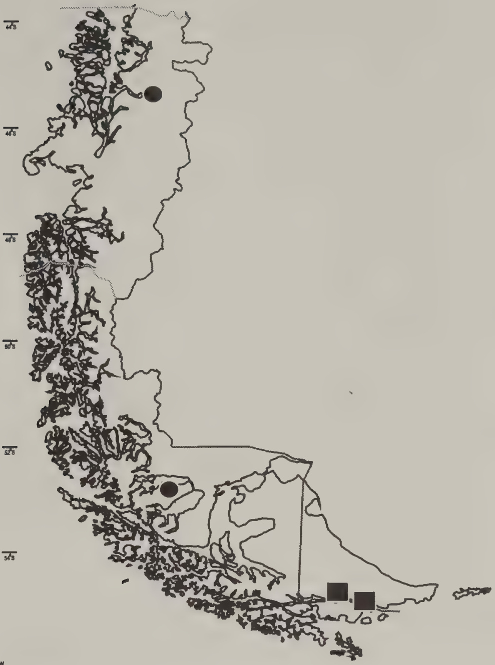

Fig. 10: Distribution of *Menegazzia neozelandica*. ● = Examined collections, ■ = Non-examined published reports. The report from Region XI is included.

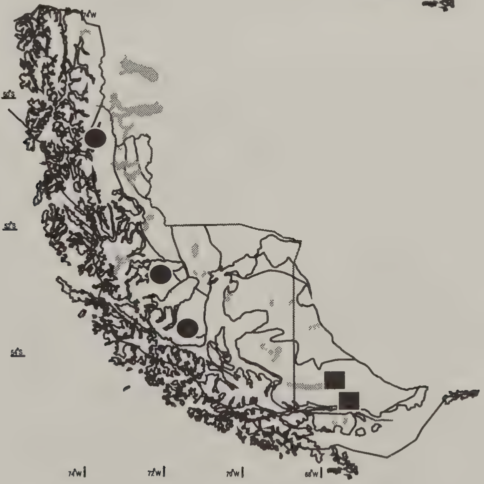

Fig. 11: Distribution of *Menegazzia norsorediata*. ● = Examined collections, ■ = Non-examined published reports.

Ecology and distribution: In southernmost Chile and Argentina in *Nothofagus* forests (Fig. 11). In Laguna El Parrillar *M. norsorediata* grows on *Nothofagus antarctica* close to the base in a swamp forest in a mosaic of other grey-lobed species of *Menegazzia* and *Hypogymnia*. It was also found on other phorophytes, such as *Berberis ilicifolia*. Adler & Calvelo (1996) state that it is both epiphytic and saxicolous. It is a rather rare species, but probably overlooked.

Discussion: Santesson (1942) distinguished between two subgenera of *Menegazzia*, viz. species having two, rarely four, ascospores in each ascus (subgenus *Dispora*) and species having eight, rarely six, spores in each ascus (subgenus *Octospora*). The number of spores suggests that *M. norsorediata* is more closely related to the Australian species *M. norstictica* than to the New Zealand species *M. pulchra*, both of which have norstictic acid in the medulla, but different numbers of spores per ascus (Galloway 1985; James & Galloway 1992).

Specimens examined: CHILE: REGION IX: Provincia de Malleco, Malalcahuello, 12 October 1987, *W. Quilhot* 12008 (UV). REGION XII: Provincia de Última Esperanza: Fiordo Andrew, 25 November 1985, *A. Newton* L131 [admixed with and labelled *Pseudocyphellaria flavicans*] (BG). Provincia de Magallanes: Isla Riesco, Mina Elena, 29 April 1940, *R. Santesson* 7815 [admixture] (S); Laguna El Parrillar, 40 km SW of Punta Arenas, 26 November 1999, *A. Elvebakk* 99:745C, 99:746B (TROM).

Menegazzia sanguinascens (Räsänen) R. Sant., Ark. Bot. 30A (11): *28* (1942).

Type: Chile: Isla Grande, Fiordo de Agostini, 22 February 1929, H. Roivainen s.n. (H, holotype, S!, syntype).

Santesson (1942) states that *M. sanguinascens* has a wide ecological amplitude in southern South America, growing both in luxuriant *Nothofagus* forests and on *Chiliotrichum diffusum* close to steppe. Santesson's morphological concept of this species is partly congruent with the concept presented here. The species was also described in detail by Calvelo & Adler (1994), and recently reported from Australia (Filson 1996).

Remarks: *M. sanguinascens* is characterized by its convex to capitate white soralia, the rather broad lobes, which in fresh material often have a distinctive salad-green colour, and the presence of hypothamnolic (UV_{366}+ white to sky blue, K+ purple) and thamnolic acids. Santesson (1942) reported the maximum width of the lobes to be 3.0 to 3.5 mm, as also experienced here. Calvelo & Adler (1994) reported the maximum width to 2.5 mm. The glossy upper surface is an important distinguishing feature. The linear to somewhat sympodially ramified lobes described by both Santesson (1942) and Calvelo & Adler (1994) are here considered as another taxonomically important feature, because all other sorediate species treated here are (sub)dichotomously to irregularly branched, except for a few deviating individuals of *M. magellanica*.

Material reported as *M. sanguinascens* by Lindsay (1973, 1974) proved to be *M. magellanica* (see under the latter species).

M. sanguinascens is a rather variable species, and lobe morphology, colour of the upper surface, and numbers and position of the soralia all vary depending on local conditions. The specimens from Isla Grande and Isla Navarino have very narrow lobes, not more than 1.1 mm wide in one specimen (*W. Quilhot* 1842), and the lobes are, as described by Calvelo & Adler (1994), greyish and dull. In specimens from luxuriant *Nothofagus betuloides-pumilio* forests in Torres del Paine National Park and near Cabo San Isidro at Brunswick Peninsula, the lobes are broad, green and glossy when dry. In stored herbarium material the vivid colour has disappeared. Soralia show a wide variation, even within one thallus, most being convex or subcapitate, but some are hollow, similar to maniciform soralia. This is probably the last stage in the development of the soralia. However, the sorediate margin is thick and may resemble doughnuts more than the cuffs of *M. magellanica*.

Chemistry: Calvelo & Adler (1994) reported atranorin, hypothamnolic and thamnolic acids. In addition, traces of norstictic acid and one unidentified depsidone were detected in the present study. Quilhot et al. (1975) reported seven different lichen compounds from *M. sanguinascens*; stictic, constictic, norstictic, and lecanoric acids, atranorin and two triterpenoids. Since *M. sanguinascens* as understood here contains substances from the thamnolic acid chemosyndrome, it is likely that Quilhot et al. (1975) analyzed material belonging to another taxon. Three of the collections listed under *M. sanguinascens* in Santesson (1942) were revised during the present study, and only one, the type specimen, contains hypothamnolic acid.

Ecology and distribution: *M. sanguinascens* is distributed throughout southernmost South America along the antiboreal rainforest zone, being most common on trunks of *Nothofagus betuloides* and *Drimys winteri*, and may also inhabit appropriate microhabitats within *N. pumilio* forests (Fig. 12). The heathland records in Santesson (1942) are probably referable to *M. magellanica* or to *M. kawesqarica*.

Selected specimens examined (total 39): CHILE: Region XII: Provincia de Última Esperanza: Torres del Paine National Park, Chorrillo de Salmones, 14 January 1989, *M. Wedin* 1154 [exsiccatae] (BG, H, O); Torres del Paine National Park, Chorrillo de Salmones, 15 March 1998, *A. Elvebakk* 98:569 (TROM); Torres del Paine National Park, E slope of Cerro Donoso, 15 March 1995, *A. Elvebakk* 95:259B (TROM), 95:271 (S). Provincia de Magallanes: Punta Arenas, 21 November 1895, *P. Dusén* 4a [admixture], 4c (S); Fuerte Bulnes, Puerto del Hambre, Punta Santa Ana, 17 December 1967, *H. Imshaug* 38730, 38747 & *R. Harris* (H); Peninsula Brunswick, Cabo San Isidro, 21 February 1998, *A. Elvebakk* 98:169 (TROM), 98:184 (H), 98:193a (TROM, S). Provincia de Tierra del Fuego: Isla Grande, Río Bueno, 9 December 1928, *H. Roivainen s.n.* (S); Canal Whiteside, Puerto Yartou, 11 February 1941, *R. Santesson* 6057 (S). Provincia de Antártica Chilena: Isla Navarino, Puerto Toro, October 1975, *W. Quilhot* 1842 (UV).
ARGENTINA: Provincia de Tierra del Fuego: Isla Grande: Tierra del Fuego National Park, Cascada Río Pipo, 8 January 1989, *M. Wedin* 1075 [admixture] (UPS); Cerro Chenen, Estancia Río Claro, 8 January 1989, *T. Ahti* 47784 (H); Estancia Moat, E side of Pampa de los Indios, 12 January 1989, *T. Ahti* 47695 (H). Isla de los Estados: Puerto San Juan, 25 October 1971, *H. Imshaug* 51826 [admixture] & *K. Ohlsson* (H).
Menegazzia tenuis R. Sant., Ark. Bot. 30A (11): *27* (1942).

Type: Chile: Isla Desolación, Puerto Angosto, 1896, P. Dusén 228a (S, holotype).

This species was previously reported from a few sites in the Magellanic Region (Santesson 1942), from Region X (Quilhot et al. 1975) and Region IV (Redon et al. 1975). It was not previously reported from Argentina (cf. Santesson 1942; Grassi 1950; Calvelo & Adler 1994; Calvelo 1998).

Remarks: *M. tenuis* is characterized by its narrow, sinuous lobes, the broadly ellipsoid perforations, and the small, maniciform soralia containing few soredia. The collections of Imshaug & Ohlsson cited below appear to have been deposited in H after Adler's revision of H material. The small number of specimens seen are all quite uniform with regard to the branching of the lobes, the broadly ellipsoid shape of the perforations, the nature and size of the soralia, and the firmly attached thallus. The largest variation seen is in thallus colour. Normally it is greyish, but occasionally it is distinctively brownish.

Chemistry: Quilhot et al. (1975) reported two lichen substances from *M. tenuis*, viz. stictic and norstictic acids. However, the present analyses did not show stictic and norstictic acids, instead a chemistry similar to that of *M. albida* (Zahlbr.) R. Sant., viz. atranorin (minor) in the cortex, and lichesterinic and protolichesterinic acids (both major) in the medulla. An unidentified substance (minor) was detected in three of the specimens. *Menegazzia tenuis* is both morphologically and chemically very similar to *M. albida*, a fertile, esorediate species with two ascospores per ascus, and is therefore considered the sorediate counterpart of *M. albida*. Santesson (1942) also indicates a close relationship between these two species. The reports by Quilhot et al. (1975) and Redon et al. (1975) are therefore considered doubtful.

Ecology and distribution: *M. tenuis* is distributed in southern Chile and Argentina northwards to Isla Desolación at latitude 53° S (Fig. 13). Although as yet only occasionally collected it appears that *M. tenuis* thrives in dense, humid forests of the antiboreal rainforest zone and is absent from the drier forests more inland and from the temperate forest zones north of the Magellanic Region. *M. tenuis* grows on the trunks of *Nothofagus antarctica*, *N. betuloides* and *N. pumilio*.

Specimens examined: CHILE: REGION XII: Provincia de Magallanes: Laguna El Parrillar, 7 December 1999, *A. Elvebakk* 99:1220 (TROM). Provincia de Tierra del Fuego: Isla Grande, Canal Whiteside, Puerto Yartou, 11 February 1941, *R. Santesson* 6058 (S). Provincia de Antárctica Chilena: Isla Hoste, Peninsula Dumas, 29 February 1940, *R. Santesson* 1312 (S). ARGENTINA: PROVINCIA DE TIERRA DEL FUEGO: Isla Grande: Bahía Buen Suceso, 14 October 1971, *H. Imshaug* 50069, 50217 & *K. Ohlsson* (H). Isla de los Estados: Bahía Primera, *H. Imshaug* 52343 & *K. Ohlsson* (H); Puerto San Juan, 25 October 1971, *H. Imshaug* 51826 [admixture] & *K. Ohlsson* (H).

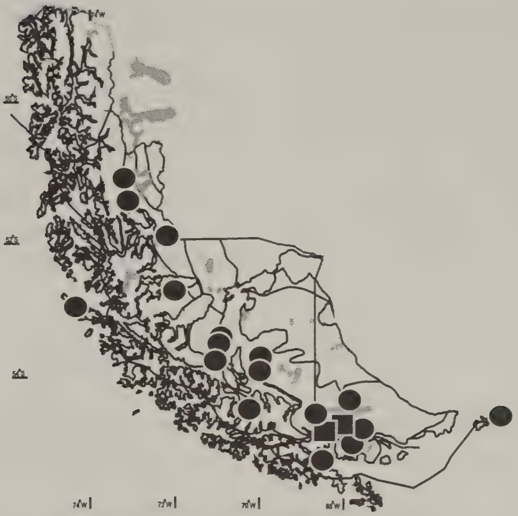
74°W
50°S
52°S
54°S
74°W
72°W
70°W
68°W

Fig. 12: Distribution of *Menegazzia sanguinascens*.
● = Examined collections, ■ = Non-examined published reports.

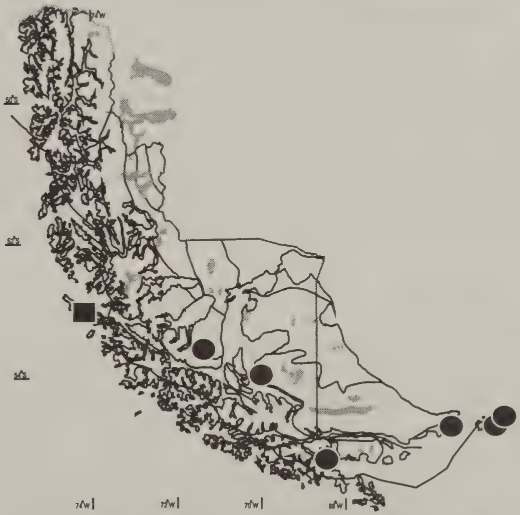
74°W
50°S
52°S
54°S
74°W
72°W
70°W
68°W

Fig. 13: Distribution of *Menegazzia tenuis*. ● = Examined collections,
■ = Non-examined published reports.

Excluded species:

Menegazzia terebrata (Hoffm.) A. Massal., *Neagaena Lichenum* 3 (1854).

This holarctic species was reported from Tierra del Fuego by Cengia Sambo (1930; cited by Grassi 1950) and by Räsänen (1932) as *Parmelia pertusa*. Santesson (1942) did not accept it for southern South America, but did not explicitly explain why it was excluded, only stating that *M. magellanica* was the South American species most resembling *M. terebrata*.

Menegazzia terebrata (Purvis et al. 1992) is distinguished from *M. kawesqarica* by the occasionally labriform soralia, the smooth upper surface, and the imbricate, glossy lobes. Chemically, *M. terebrata* is very similar to *M. kawesqarica, M. magellanica* and *M. neozelandica.*

ACKNOWLEDGEMENTS

The authors wish to thank the curators of the herbaria AAS, H, HIP, HO, O, S, UPS, and UV for loan of material. We are most grateful to Prof. Wanda Quilhot, Universidad de Valparaíso, for providing us with many of her own lichen collections and some lichen data, and for giving assistance both on chemistry and taxonomy, and not at least encouragement during the course of this investigation. The staff at Instituto de la Patagonia, Universidad de Magallanes, especially Erwin Domínguez, and the CONAF rangers in Torres del Paine National Park are indebted for giving logistic assistance during several expeditions in the Magellanic Region. We are grateful to Dr. Christian Printzen, University of Bergen, for checking the Latin diagnosis, to Mr. Dag Olav Øvstedal, University of Bergen, for arranging the loans from AAS, and to Gunvor Granaas, University of Tromsø, for taking the stereomicroscope photographs. Dr. David J. Galloway, Landcare Research, New Zealand, is greatly acknowledged for his critical and constructive revision of the manuscript. Parts of the first author's expenses were covered by Centre for Environmental and Development Studies, University of Tromsø. The second author acknowledges financial support from the Norwegian Research Council and the Norwegian Institute of Air Research.

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MYCOTAXON

Volume LXXVIII, pp. 393-405 April-June 2001

STUDIES IN NEOTROPICAL POLYPORES 9
A CRITICAL CHECKLIST OF POROID FUNGI FROM VENEZUELA

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Abstract

239 poroid species are registered from Venezuela out of which 64 are reported as new to the country. *Coltricia pyrophila* is reported as new for America.

Key words: Polyporaceae.

Introduction

The poroid fungi of Venezuela are fairly well known because of a long history of collecting and the publication of two checklists (Fidalgo 1968, Holmquist, et al. A. 1995). However, both checklists have serious flaws as they report many names taken from old literature which today are known to be synonyms (see Ryvarden 1982, 1983 & 1984). Thus, the number of species in these lists are inflated making them less reliable as a source of information.

Further, the list of Holmquist et al. (1995) includes a number of boreal species, the occurrence of which in Venezuela is dubious. This is especially so since there is no reference from where the names have been taken from, nor to the herbaria where specimens eventually have been examined. Species in this category are listed in the end as "excluded species" to which the reader is referred for further details.

Fidalgo (1968) and Holmquist et al. (1995) have given a detailed and accurate survey of previous collectors of polypores in

Venezuela in their reports, and the reader is referred to these publications for details. Later, smaller contributions have been given by Calonge, Núñez & Ryvarden (1996), Decock & Ryvarden (1999a & b), Rodriguez, Burdsall & Volk (1995), Ryvarden (1983, 1984, 1985 &1987) & Setliff (1984). Publications dealing with fungal collectors in Venezuela, in which collectors of polypores are mentioned, are, Dennis (1970) Guariglia & Iturriaga (1980), Pons (1983), Nishida (1989), Iturriaga & Ryvarden (2000), Iturriaga et al. (2000).

The present checklist includes information from all these studies besides results from our own collecting undertaken in recent years, which have yielded several new species for the country. Further, the senior author has studied a large collection of South American polypores accumulated over the years in the New York Botanical garden including a number of Venezuelan specimens.

Data on locality is only given for the species that the authors of this paper have collected in Venezuela. Locality data for the species´ names taken from the literature are not given, but reference is given in brackets after each species name. Neither locality nor literature reference data are given for species´ names taken from Holmquist et al. (op. cit.). In order to save space our main collecting sites are abbreviated as follows:

Aponwao: Estado Bolívar, Gran Sabana, 1 km east of Estación Aponwao, 23-24 Feb 2000.
Las Nieves: Estado Bolívar, Hato Las Nieves, 12-17 Jun 1995.
Rancho Grande, Estado Aragua, Parque Nacional Henri Pittier, Rancho Grande Research Station. 19-22 Nov 1994, 19-24 Jun 1995, 20-25 Apr 1998, 22-25 Apr1999, 17-19 Feb 2000.
Sanmaria: Estado Amazonas, Sanmaria Indian Community, 20 km east of Puerto Ayacucho, 17-20 April 1999.
Sifontes: Estado Bolívar, Sifontes, east of Tumeremo, 10-16 Nov 1994.
Yutajé: Estado Amazonas, Yutajé, 10-17 Jun 1997.

In the following, the species are placed alphabetically first according to families where poroid species are represented, and within each family alphabetically according to genus. Inside each genus, species are placed alphabetically according to specific epithet.

Species new to Venezuela are marked with an * . and specimens of these species are deposited in VEN and O. This information is not reported for each species. Holotypes and the first set from the authors collections are deposited in VEN, in abidance to Venezuelan collecting permits.

The nomenclature is according to Ryvarden & Johansen (1980) and Gilbertson & Ryvarden (1986-87).

List of poroid species known from Venezuela.
CORTICIACEAE (Poroid representatives)
Grammothele Berk. & M. A. Curtis
G. fuligo (Berk. & Br.) Ryvarden,
**G. lineata* Berk. & M. A. Curtis, Las Nieves,
G. subargentea (Speg.) Rajchenb.,
Porogramme Pat.
**P. albocincta* (Cooke & Masse) Lowe, Sifontes,
**P. lateritia* Pat., Yutajé,
Trechispora P. Karst.
**T. brasilensis* Corner,Yutajé,
**T. dimitica* (Ryvarden,) Larsson, Yutajé,
**T. mollusca* (Fr.) Liberta, Yutajé,
**T. regularis* (Murrill) Liberta, Sifontes,

GANODERMATACEAE
Amauroderma Murrill
A. auriscalpium (Pers.) Torrend,
A. boleticeus (Pat. & Gaillard) Torrend,
A. calcigenum (Berk.) Torrend,
A. camerarium (Berk.) Furt.,
A. dubiopansum (Lloyd) Dennis,
A. exile (Berk.) Torrend,
A. gusmanianum Torrend,
**A. macrosporum* Furt., Yutajé,
A. omphalodes (Berk.) Torrend,
A. partitum (Berk.)Wakefield, Aponwao,
**A. praetervisum* (Pat.) Torrend, Aponwao,
A. schomburgkii (Mont. & Berk.) Torrend, Rodriguez et al. 1995,
**A. sprucei* (Pat.) Torrend,Yutajé,
**A. trichodermatum* Furt., Aponwao,
Ganoderma P. Karst.
*G. austra*le (Fr.) Pat.,
G. colossus (Fr.) Baker,
**G. longistipitatum* Ryvarden, Yutajé,
**G. multicornis* Ryvarden, Yutajé,
G. oerstedtii (Fr.)Torrend, Calonge et al. 1996,

G. orbiforme (Fr.) Ryvarden, Sanmaria,
G. resinaceum Boud.,
**G. stipitatum* Murrill, Sanmaria,
Haddowia Stey.
**H. longipes* (Lév.) Stey., Sanmaria,
Humphreya Stey.
**H. coffeatum* (Berk.) Stey. , Sanmaria,
**H. neurosporum* (Furt.)Stey., Yutajé.

HYMENOCHAETACEAE

Aurificaria D. Reid
A. luteoumbrina (Romell) D. Reid, Sifontes,
Coltricia S. F. Gray
C. hamata (Romell) Ryvarden,
**C. pyrophila* (Wakef.) Ryvarden, Yutajé, new to America. Previously known only from Sierra Leone and Nigeria (Ryvarden & Johansen 1980:111). The Venezuelean collection was found in an old fire place as was the case with the African collections and reflected in the specific epithet.
Cyclomyces Fr.
C. iodinus (Mont.) Pat.,
C. tabacinus (Mont.) Pat.,
Inonotus P. Karst.
I. splitbergeri (Mont.) Ryvarden,
I. venezuelicus Ryvarden, Ryvarden 1987,
Phellinus Quel.
**P. apiahynus* (Speg.) Rachj. & J. E. Wright, Aponwao,.
P. aureobrunneus Wright & Blumenf.,
P. badius (Berk. & M. A. Curtis) G. H. Cunn. s. lato,
**P. calcitratus* (Berk. & M. A. Curtis) Ryvarden, Yutajé,
P. callimorphus (Lév.) Ryvarden, Calonge et al. 1996,
P. caryophylleus (Cooke) Ryvarden,
**P. chryseus* (Lév.) Ryvarden, Yutajé,
P. contiguus (Fr.) Pat. Rancho Grande,
**P. detonsus* (Mont.) Ryvarden, Rancho Grande,
P. extensus (Lév.) Pat.,
P. fastuosus (Lév.) Ryvarden,
P. ferreus (Pers.) Bourdot & Galzin, Setliff 1984,
P. gilvus (Schw.) Pat.,
P. grenadensis (Murrill) Ryvarden,

P. johnsonianus (Murrill) Ryvarden,
**P. maxonii* (Murrill) Reid, Las Nieves,
P. melleoporus (Murrill) Ryvarden,
P. merrillii (Murrill) Ryvarden, Calonge et al. 1996,
P. portoricensis (Overholts.) Fidalgo,
**P. punctatiformis* (Murrill) Ryvarden, Sifontes,
P. punctatus (Fr.) Pilat,
**P. rhytiphloeus* (Mont.) Ryvarden, Aponwao,
P. robiniae (Murrill) Ames,
P. roseocinereus (Murrill) Reid, Calonge et al. 1996,
P. sanctigeorgii (Pat.) Ryvarden,
P. sarcites (Fr.) Ryvarden,
P. senex (Nees & Mont.) Imaz.,
**P. shaferi* (Murrill) Ryvarden, Rancho Grande
**P. umbrinellus* (Bres.) Ryvarden, Sifontes,
**P. undatus* (Murrill) Ryvarden, Yutajé,
**P. undulatus* (Murrill) Ryvarden, Yutajé,
**P. wahlbergii* (Fr.) Reid, Aponwao,
Phylloporia Murrill
**P. chrysita* (Berk.) Ryvarden, Yutajé,
P. frutica (Berk. & M. A. Curtis) Ryvarden,
P. pectinata (Kl.) Ryvarden,
P. spathulata (Hook.) Ryvarden,

POLYPORACEAE (s. lato)
Abundisporus Ryvarden,
A. fuscopurpureus (Pers.) Ryvarden, Aponwao,
Amylosporus Ryvarden,
A. campbellii (Berk.) Ryvarden,
Antrodia P. Karst.
A. albida (Fr.) Donk,
A. gossypina (Speg) Ryvarden,
Antrodiella Ryvarden, & Johans.
**A. angulatopora* Ryvarden, Rancho Grande,
**A. duracinus* (Pat.) Ryvarden, Aponwao,
A. hydrophila (Berk. & M. A. Curtis) Ryvarden, Rodriguez et al.1995,
A. incrustans (Cooke) Ryvarden,
**A. liebmannii* (Fr.) Ryvarden, Rancho Grande,
A. semisupina (Berk. & M. A. Curtis) Ryvarden,
**A. subundata* (Murrill) Ryvarden, Yutajé,

A.versicutis (Berk. & M. A. Curtis) Gilb. & Ryvarden.
Bjerkandera P. Karst.
B. adusta (Fr.) P. Karst.,
B. fumosa (Pers.:Fr.) P. Karst.
Ceriporia Donk
C. alachuana (Murrill) Hallenb.,
**C. microspora* Lindbl. & Ryvarden, Rancho Grande,
C. purpurea (Fr.) Donk,
**C. spissa* (Schw.:Fr.) Rajchenberg, Rancho Grande,
C. tarda (Berk.) Ginns,
C. xylostromatoides (Berk.) Ryvarden.
Ceriporiopsis Domanski
C. umbrinescens (Murrill) Ryvarden, Setliff 1984.
Coriolopsis Murrill
C. byrsina (Mont.) Ryvarden,
C. floccosa (Jungh.) Ryvarden, Calonge et al. 1996,
C. fulvocinerea Murrill,
C. polyzona (Pers.) Ryvarden,
C. rigida (Berk. & Mont.) Murrill, Rancho Grande.
Daedalea Fr.
**D. aethalodes* (Mont.) Rajchenb., Aponwao,
D. microsticta Cooke,
D. quercina Fr. ,
D. stereoides (Fr.) Ryvarden.
Datronia Donk
D. brunneo-leuca (Berk.) Ryvarden, Calonge et al. 1996,
D. caperata (Berk.) Ryvarden,
**D. scutellata* (Schw.) Gilb. & Ryvarden, Yutajé,
D. stereoides (Fr.) Ryvarden.
Dichomitus D. Reid
**D. cavernulosus* (Berk.) Masuka & Ryvarden, Rancho Grande,
**D. setulosa* (Henn.) Masuka & Ryvarden, Aponwao,
Diplomitoporus Domanski
**D. incisus* Ryvarden, Yutajé.
Earliella Murrill
E. scabrosa (Pers.) Gilb. & Ryvarden.
Echinochaete D. Reid
**E. brachyporus* (Mont.) Ryvarden, Yutajé.
Echinopora Ryvarden
**E. aculeifera* (Berk. & M. A. Curtis) Ryvarden, Sartenejas.

Flaviporus Murrill
F. brownii (Humboldt) Donk.
Fomes (Fr.) Fr.
F. fasciatus (Schw.) Cooke.
Fomitella Murrill
F. supina (Swartz:Fr.) Murrill.
Fomitopsis P. Karst.
F. cupreo-roseus (Berk.) Carranza & Gilb.,
**F. durescens* (Lowe) Gilb. & Ryvarden, Rancho Grande,
F. feei (Fr.) Kreisel,
F. meliae (Underw.) Gilb. & Ryvarden,
F. nivosa (Berk.) Gilb. & Ryvarden,
F. palustris (Berk. & M. A. Curtis) Gilb. & Ryvarden.
Fuscocerrena Ryvarden,
F. portoricensis (Fr.) Ryvarden.
Gloeophyllum P. Karst.
G. striatum (Fr.) Murrill,
G. trabeum (Fr.) Murrill.
Gloeoporus Mont.
**G. dichrous* (Fr.) Bres., Aponwao,
**G. thelephoroides* (Hook.) G. Cunn., Las Nieves.
Hapalopilus P. Karst.
H. phlebiaeformis (Cooke) Ryvarden, Ryvarden 1988.
Hexagonia Fr.
H. capillacea Pat. & Gaill.,
H. glabra (Beauvois) Ryvarden,
**H. hirta* (Fr.) Fr., Las Nieves,
H. hydnoides (Fr.) Fidalgo,
**H. leprosa* Fr., Aponwao,
H. papyracea Berk.
Junghuhnia Corda
**J. carneola* (Bres.) Rajchenb., Rancho Grande,
**J. neotropica* Lindbl. & Ryvarden, Aponwao,
J. nitida (Fr.) Ryvarden,
J. polycystidifera (Rick) Rajchenb., Sanmaria,
J. semisupiniformis (Murrill) Ryvarden, Sifontes.
Laetiporus Murrill
L. percicinus (Berk. & M. A. Curtis) Gilb., Yutajé,
L. sulphureus (Fr.) Murrill.
Lenzites Fr.

L. acuta Berk. Calonge et al. 1996.
Melanoporiella Murrill
M. carbonacea (Berk. & M. A. Curtis) Murrill, Lowe 1966.
Microporellus Murrill
M. dealbatus (Berk. & M. A. Curtis) Murrill,
M. obovatus (Jungh.) Ryvarden.
Navisporus Ryvarden
N. floccosa (Bres.) Ryvarden.
Nigrofomes Murrill
N. melanoporus (Mont.) Murrill, Yutajé.
Nigroporus Murrill
N. vinosus (Berk.) Murrill, Sifontes.
Oligoporus Bref.
O. balsameus (Pk.) Gilb. & Ryvarden,
O. caesius (Fr.) Gilb. & Ryvarden,
O. floriformis (Quel.) Gilb. & Ryvarden,
O. hibernicus (Berk.& Br.) Gilb. & Ryvarden,
O. placentus (Fr.) Gilb. & Ryvarden,
O. tephroleucus (Fr.) Gilb. & Ryvarden.
Oxyporus Donk
O. latemarginatus (Durand & Mont.) Donk,
O. obduscens (Pers.) Donk, Sifontes,
O. pellicula (Jungh.) Ryvarden,
O. similis (Bres.) Ryvarden.
Pachykytospora Kotlaba & Pouzar
P. alabamae (Schw.) Ryvarden, Setliff 1984,
P. papyracea (Schw.) Ryvarden.
Perenniporia Murrill
**P. aurantiaca* Decock & Ryvarden, Las Nieves,
P. chromatica (Berk. & M. A. Curtis) Decock & Ryvarden,
**P. contraria* (Berk. & M. A. Curtis) Ryvarden, Yutajé,
P. detritus (Berk.) Ryvarden, Decock & Ryvarden 1999,
P. inflexibilis (Berk.) Ryvarden,
P. isabellinus (Pat.) Ryvarden,
**P. martius* (Berk.) Ryvarden, Aponwao,
P. medullapanis (Fr.) Donk,
P. ochroleuca (Berk.) Ryvarden,
P. parvispora Decock & Ryvarden, Decock & Ryvarden 2000,
P. roseoisabellina (Pat. & Gaill.) Ryvarden,
P. sprucei Decock & Ryvarden ,Yutajé,

P. tenuis (Schw.) Ryvarden, Setliff 1984,
**P. tepeitensis (*Murrill) Ryvarden, Rancho Grande,
P. tephropora (Mont.) Ryvarden,
**P. xantha* Decock & Ryvarden, Las Nieves.
Physisporinus P. Karst.
P. sanguinolentus (Alb. & Schw.:Fr.) Pilat, Setliff 1984.
Polyporus Fr.
P. arcularius Fr.,
P. dictyopus Mont.,
**P. grammocephalus* Berk., Rancho Grande,
P. guianensis Mont.,
P. leprieurii Mont.,
**P. phillipinensis* Berk., Yutajé,
P. tenuiculus Beauv.: Fr.,
P. tricholoma Mont.
Protomerulius Møller
P. caryae (Schw.) Ryvarden, Setliff 1984.
Pseudofavolus Pat.
P. cucullatus (Mont.) Pat.,
P. nigrus Ryvarden, Ryvarden1987
P. orinoccensis (Pat.) Ryvarden.
Pycnoporus Murrill
P. sanguineus (Fr.) Murrill.
Pyrofomes Kotl. & Pouzar
P. fulvo-umbrina (Bres.) David & Rajchenb.,
**P. laeteritius* (Cooke) Ryvarden, Sanmaria.
Rigidoporus Murrill
**R. biokoensis* (Lloyd) Ryvarden, Sanmaria,
**R. crocatus* (Pat.) Ryvarden, Sifontes,
R. lineatus (Pers.) Ryvarden,
R. microporus (Fr.) Overeem,
R. mutabilis Lindbl. & Ryvarden, Sartenejas,
R. ulmarius (Fr.) Imazeki,
R. umbonatipes Rajchenb.,
*R. undatus (*DC) Donk,
R. vinctus (Berk.) Ryvarden.
Schizopora Vel.
S. cystidiata David & Rajchenberg, Sartenejas,
S. flavipora (Cooke) Ryvarden,
S. paradoxa (Fr.) Donk,

S. radula (Fr.) Hallenb.
Skeletocutis
S. lenis (P. Karst.) Niemelä, Aponwao.
Stiptophyllum Ryvarden
**S. erubescens* (Berk.) Ryvarden, Las Nieves,
Tinctoporellus Ryvarden,
T. epimiltinus (Berk.) Ryvarden, Rodriguez et al. 1995.
Trametes Fr.
T. cingulata Berk.,
T. cubensis (Mont.) Pat. & Lagerh.,
T. elegans (Spreng.:Fr.) Fr.,
T. ellipsospora Ryvarden, Ryvarden1987,
T. hirsuta (Fr.) Pilat,
T. lactinea Berk.,
T. maxima (Mont.) David & Rajchenb.,
T. membranacea (Sw.:Fr.) Kreisel, Rodriguez et al. 1995,
**T. modesta* (Fr.) Ryvarden, Aponwao,
T. pavonia (Hook.) Ryvarden,
T. versicolor (Fr.) Pilat,
T. villosa (Fr.) Kreisel.
Trichaptum Murrill
T. abietinus (Fr.) Ryvarden,
T. biforme (Fr.) Ryvarden,
T. byssogenum (Jungh.) Ryvarden, Calonge et al. 1996,
T. durus (Jungh.) Corner,
T. fumosavellanea (Romell) Rajchenb. & Bianchin., Sifontes,
T. perrottetii (Lév.) Ryvarden,
T. sector (Ehrenb.) Kreisel,
**T. sprucei* (Berk.) Rajchenb. & Bianchin., Las Nieves.
Tyromyces Karst.
T. caesioflavus (Pat.) Ryvarden, Calonge et al. 1996,
T. chioneus (Fr.) P. Karst.,
**T. leucomallus* (Berk. & M. A. Curtis) Murrill, Rancho Grande.
Wolfiporia Ryvarden, & Gilb.
W. cocos (Schw.) Ryvarden, & Gilb.
Wrightoporia Pouz.
**W. avellanea* (Bres.) Pouzar, Aponwao,
**W. tropicalis* (Cooke) Ryvarden, Sifontes.

Excluded species

The following species listed by Holmquist et al. (1995) are omitted from the checklist since they all have a distinct boreal distribution in the Northern hemisphere. This and the fact that many of them are more or less restricted to *Picea* make it highly improbable that they occur in Venezuela.

Anomoporia bombycina (Fr.) Pouzar,
Antrodiella fissiliformis (Pilat) Gilb. & Ryvarden,
Climacocystis borealis (Fr.) Kotlaba & Pouzar,
Dichomitus squalens (P. Karst.) D. Reid,
Diplomitoporus crustulinus (Bres.) Domanski,
Inonotus radiatus (Sow.:Fr.) P. Karst.,
Ischnoderma resinosum (Fr.) P. Karst.,
Junghuhnia collabens (Fr.) Ryvarden,
Phellinus conchatus (Pers.:Fr.) Quel.,
Phellinus igniarius (L.:Fr.) Quel.,
Trametes velutinus (Fr.) Pilat.

Acknowledgements

The Norwegian Research Council and the Nansen Foundation, Oslo have provided funds for several of the collecting trips and we are grateful for their generous support. Universidad Simón Bolívar's logistic and financial support to the authors through several years is gratefully acknowledged. Mario Rajchenberg has acted as presubmission reviewer, while Richard P. Korf has read the manuscript and suggested linguistic improvements. Their help is deeply acknowledged.

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MYCOTAXON

Volume LXXVIII, pp. 407-411 April-June 2001

IDENTIFICATION OF THE PHOTOBIONTS IN TRAPELIOPSIS AND PERTUSARIA USING SSU RIBOSOMAL DNA SEQUENCES OBTAINED FROM PCR AMPLIFICATION WITH A NON-GREEN-ALGAL PRIMER

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ABSTRACT: It is reported that the non green-algal primer nu-SSU-0402-5' amplifies algal DNA in the lichen species *Pertusaria lophocarpa, Trapeliopsis flexuosa* and *T. granulosa.* The photobionts of these lichens are confirmed to belong to the genera *Trebouxia* and *Chlorella,* respectively.

KEYWORDS: lichens, molecular phylogeny, 18S rDNA, primer

Systematic studies on lichen-forming fungi are enhanced by the introduction of molecular markers, especially since primers were developed which allow to specifically amplify fungal ribosomal DNA (Gargas & Taylor 1992, Gargas & DePriest 1996). With the help of these primers fungal DNA sequences can be determined without the isolation of the mycobiont from a lichen. Non-green algal primers are now available for the amplification of the SSU rDNA, LSU rDNA, and ITS genes (Gardes & Bruns 1993, Gargas & DePriest 1996, Crespo *et al.* 1997, Döring *et al.* 2000) from lichen mycobionts.

In our studies we revealed puzzling results when we used the non-green algal primer nu-SSU-0402-5' (formerly named NS19UCB) (Gargas & DePriest 1996). We used this primer in combination with the universal primer nu-SSU-1412-3' (=NS6) (White *et al.* 1990) for the PCR amplification of fungal SSU rDNAs in three lichen species.

MATERIALS AND METHODS

The examined lichen species were *Pertusaria lophocarpa* Körber (Australia, Victoria, Basalt Hill, 1994, *Elix & Streimann* [ESS 15617], (accession no. AY004347), *Trapeliopsis flexuosa* (Fr.) Coppins & P. James (Germany, NRW, Stellberg, 2000, *Lumbsch & Schmitt* [ESS 20963], (accession no. AY004348), and *T. granulosa* (Hoffm.) Lumbsch (Germany, NRW, Stellberg, 2000, *Lumbsch & Schmitt* [ESS 20962], (accession no. AY004349). DNA isolation, PCR reaction (annealing temperature 52°C) and sequencing were carried out as described previously (Lumbsch & Schmitt 2000). The obtained sequence fragments were assembled with SeqMan 4.03 (DNAStar).

BLAST searches revealed high similarities of the obtained sequences with green algal SSU rDNA sequences. The sequences from *T. flexuosa* and *T. granulosa* showed 96% and 98% similarity with the SSU rDNAs from *Chlorella ellipsoidea* Gerneck (accession no. X63520) and 94% and 96% similarity with *C. mirabilis* Andreyeva (accession no. X74000), respectively. The obtained rDNA sequence from *P. lophocarpa* shared 99% similarity with *Trebouxia asymmetrica* Friedl & Gärtner (accession no. Z21553) and *T. jamesii* (Hildereth & Ahmadjian) Gärtner (accession no. Z 68700). Multiple alignments of the sequences obtained from these lichens with those from the above green algae were generated using Clustal W (Thompson *et al.* 1994) and manually optimized. Portions of the alignment with ambiguous positions that may not be homologous were eliminated using the computer program Gblocks (Castresana 2000) with default options for ribosomal genes.

The alignment was analysed using the PAUP* 4.0 software package (Swofford 1998). Maximum parsimony (MP) trees were inferred using the branch-and-bound search option. Gaps were treated as missing data. Branch lengths equal to zero were collapsed to polytomies. Nonparametric bootstrap support (Felsenstein 1985) for each clade was tested based on 10000 replications, using the branch-and-bound bootstrap option of PAUP*4.0. Phylogenetic trees were drawn using Treeview (Page 1996). The consistency index (CI), retention index (RI), and rescaled consistency index (RC) were obtained from PAUP*.

RESULTS AND DISCUSSION

More than 98% of the sequence lengths were sequenced in both directions in all species. Sequences of the seven taxa (only positions from positions 403 to 1412 relative to *Saccharomyces cerevisiae* standard [Rubtsov *et al.* 1980, Mankin, Skryabin & Rubtsov 1986] were included) were aligned to produce a matrix of 1010 nucleotide-position characters. Gblocks selected conservative blocks for phylogenetic analysis with 1006 positions (i.e. 99 % of the original positions), which included 42 parsimony-informative sites. The alignment is available in TreeBASE SN539 (http://herbaria.harvard.edu/treebase/).

Two most parsimonious trees with a length of 68 steps were obtained (Fig. 1) (CI=0.94, RI=0.96, and RC=0.92). The sequences obtained from the *Trapeliopsis* spp. clustered with *Chlorella ellipsoidea*, suggesting that the sequences obtained belong to the photobiont of the lichen. The two trees only differed in having either the photobiont of *Trapeliopsis granulosa* and *T. flexuosa* as sister-groups or *Chlorella ellipsoidea* and the photobiont of *T. granulosa* as sister-groups. *Chlorella ellipsoidea* has been described as the photobiont of the closely related *Trapelia coarctata* (Tschermak-Woess 1978).

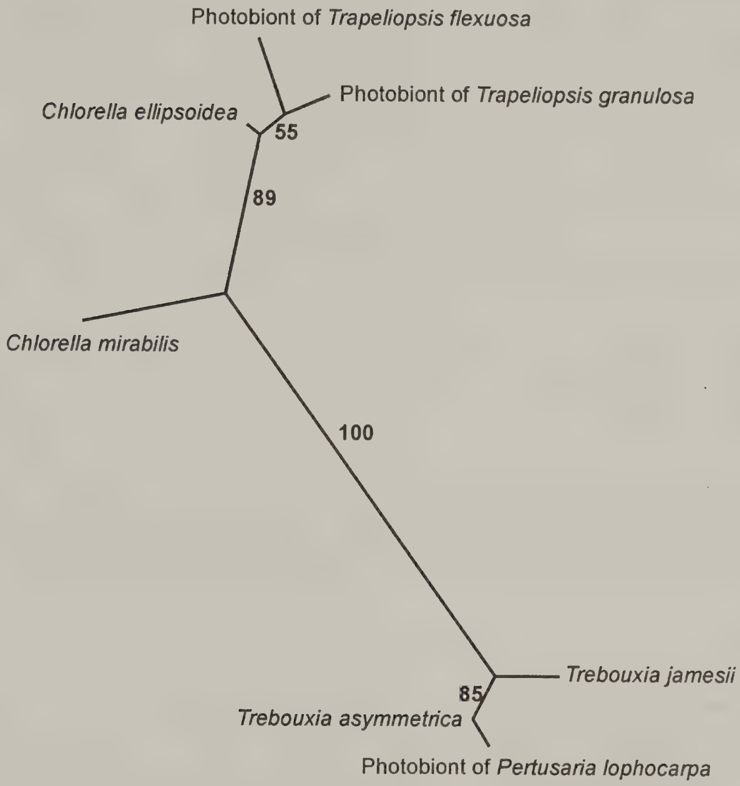
Photobiont of Trapeliopsis flexuosa
Photobiont of Trapeliopsis granulosa
Chlorella ellipsoidea
55
89
Chlorella mirabilis
100
Trebouxia jamesii
85
Trebouxia asymmetrica
Photobiont of Pertusaria lophocarpa

Fig. 1. Unrooted phylogram based on algal SSU rDNA. One of two most parsimonious trees obtained from a branch-and bound search using PAUP*. Bootstrap support values are shown.

The sequence from *Pertusaria lophocarpa* clustered with *Trebouxia asymmetrica* indicating that this algal species may be the photobiont of this lichen. The related *Trebouxia potteri* was reported from Japanese *Pertusaria* species (Takeshita *et al.* 1989).

Our results suggest that we amplified the photobiont DNA and not DNA from the mycobiont using primer nu-SSU-0402-5' which was formerly believed to be non-green algal (Gargas & DePriest 1996). We compared the sequence portion of the algal alignment at position 381-402 (relative to the *Saccharomyces cerevisiae* standard) with the sequence of the primer nu-SSU-0402-5'. This primer differed only at one position from the Chlorella spp. and at two positions from the *Trebouxia* spp. sequences (Tab. 1). As our results showed, despite these differences amplification of green algal sequences is still possible. Therefore, the primer nu-SSU-0402-5' cannot be used with nonspecific primers, but must be used in combination with a primer that cannot amplify green algal sequences to specifically amplify fungal sequences from lichen thalli.

Tab. 1. Comparison of sequences of primer nu-SSU-0402-5' and selected green algae at positions 381-402.

5'→3'	Sequence
Primer nu-SSU-0402-5' (=NS19UCB)	CCGGAGAAGGAGCCTGAGAAAC
Chlorella ellipsoidea	G
Chlorella mirabilis	G
Trebouxia asymmetrica	G G
Trebouxia jamesii	G G

Dr. Christian Printzen (Bergen) and Prof. Dr. Thomas Friedl (Götingen) are thanked for helpful comments on the manuscript. Armin Mangold provided excellent technical assistance. This study was supported by the Deutsche Forschungsgemeinschaft.

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MYCOTAXON

Volume LXXVIII, pp. 413-422 April-June 2001

ASPERGILLUS FROM BRAZILIAN MOSQUITOES - I. GENERA AEDES AND CULEX FROM RIO DE JANEIRO STATE

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Key words: Aspergillus, Aedes spp., Culex spp.

Abstract

As part of an ongoing survey of potential biological control fungi from insects in Brazil, aspergilli were isolated from 625 mosquitoes belonging to 17 species in the genera *Aedes* and *Culex*. Two hundred and fifteen isolates belonging to 17 *Aspergillus* species were found. *Aspergillus niger*, *Aspergillus flavus* and *Aspergillus nidulans* were the most frequently isolated species. Two other species, *Aspergillus fischerianus* and *Aspergillus heteromorphus* were new records for insects. The macro- and microcharacteristics of the Brazilian isolates are compared to those in previously published descriptions. The habitat and geographical distribution of these fungi in Brazil is reviewed.
Key words: biological control; taxonomy; entomogenous fungi

Introduction

The subgenera *Culex* and *Melanconion* of the genus *Culex* and *Stegomyia* and *Ochlerotatus* of the genus *Aedes* include the most important vectors of insect-born diseases of man and domestic animals, such as bancroftian filariasis (*Culex quinquefasciatus* Say), dengue and yellow fever (*Aedes aegypti*), chicken malaria (*Culex saltanensis*), dirofilariasis (*Aedes taeniorhynchus*, *Aedes scapularis*) and several arboviruses (*Culex nigripalpus* and several other species belonging to subgenera *Culex* and *Melanconion*) (Consoli & Lourenço-de-Oliveira, 1998).

For many years chemical pesticides have been used successfully to control these vectors. Unfortunately more than 200 species of medically important arthropods have become resistant to many contemporary pesticides. Biological control became one of the more rapidly growing alternative vector control strategies and the interest in their applications for the control of human and animal disease vectors has increased during the past decades (Dobrokhotov, 1993).

The genus *Aspergillus* is widely distributed in nature, on various substrates and in the most varied environmental conditions (Samson & Pitt, 1985). Their relationships with different insects is widely described in the specialized literature (Dubrovskiy & Rybal Chenko, 1993; Hay *et al.*, 1993) but relatively little is known about the relations between this fungal genus and insects vectoring tropical diseases (Moraes, *et al.*, 1998; Schlein *et al.*, 1985). The entomopathogenic and entomotoxigenic potential of *Aspergillus* still is an aim of several studies, mainly for application in biotechnology and secondary metabolite production (Powell *et al.*, 1994; Laakso & Gloer, 1993).

The objective of the present study was to isolate and identify *Aspergillus* spp. from mosquitoes belonging to the genera *Culex* and *Aedes*.

Material and Methods

The *Aspergillus* strains were isolated from 675 mosquitoes belonging to 17 species: *Aedes (Stegomyia) aegypti, Ae. (Ochlerotatus) fluviatilis, Ae. (Och.) scapularis, Ae. (Protomacleaya) terrens, Ae. (Och.) rhyacophilus, Ae.(Ochlerotatus) sp., Ae. (Och.) taeniorhynchus, Culex (Culex) chidester, Cx. (Cux.) coronator, Cx. (Cux.) declarator, Cx. (Cux.) nigripalpus, Cx. (Cux.) quinquefasciatus, Cx. (Cux.) saltanensis, Culex sp., Cx. (Melanconion) sp., Cx. (Microculex) imitator* and *Cx. (Microculex) sp.* The mosquitoes were collected from natural and artificial breeding sites in the Municipality of Rio de Janeiro (Vargem Grande, Ramos, Santa Cruz and Lins), Duque de Caxias, Itaboraí (Porto das Caixas), Rio das Ostras, Magé (Parque Nacional da Serra dos Órgãos) and Guapimirim (Rio Guaraí).

The collected mosquitoes were observed microscopically in order to visualize fungal infections, but none of them had any sign of fungal infection. Then they were washed with a 1% sodium hypochlorite solution 1 minute and rinsed twice with sterile distilled water, 1 minute each time. After that they were transferred to Petri dishes containing Sabouraud Dextrose Ágar medium with 3g Yeast extract - Difco (SDAY) and to Erlenmeyers flasks containing Peptone broth, yeast extract and glucose (PYG)-Difco, both with 50.0mg added chloranphenicol (Sigma). The Petri dishes and Erlenmeyers flasks were incubated at a room temperature and examined daily for 21 days (Seymour *et al.*, 1984). The colonies were counted and transferred to Potato Dextrose Agar (Difco) (PDA) slants.

Strains identified as *Aspergillus* spp. were transferred to Petri dishes with 9cm diameter containing the following media and incubation temperature: Czapek Yeast extract agar at 25^0C and 37^0C and Malt extract agar at 25^0C (Klich & Pitt, 1994). Conidial colors were observed and the color designations used throughout the taxionomic descriptions are from Kornerup & Wanscher (1978) and appear inside parentheses following the color names. The growth rates of the colonies were measured after 7 days of incubation using a Mitutoyo digimatic calipter with 0.01mm resolution.

The microscopic characteristics presented by the *Aspergillus* species were studied using slide culture technique. Material was mounted in 10% KOH for the dark pigmented isolates and Amann Lactophenol with cotton blue for the remaining isolates, and all of them were observed through a Nikon model Labophot light microscope. Measurement of the structures (vesicles, conidia, metulae, phialides, etc) are given as an average of 50 measurements of each structure. The following studies were used for identification of the *Aspergillus* isolates: Raper & Fennell (1965), Christensen & Raper, (1978), Samson (1979), Christensen (1981), Christensen (1982), Christensen & States (1982), Samson & Pitt (1985), Kozakiewicz (1989), Klich (1993) and Klich & Pitt (1994).

Information on geographical distribution and prevalence of *Aspergillus* species in Brazil was obtained from the studies by Homrich (1961), Dunn *et al.* (1989), Araújo *et al.* (1992) and Silva & Minter (1995), who assembled all the studies by Batista and coworkers of several Brazilian regions, as well as by Castro *et al.*(1995), Sarquis & Oliveira (1996), Corrêa *et al.* (1997), Alves & Castro (1998) and Moraes *et al.* (1998).

Results and Discussion

Two hundred fifteen *Aspergillus* strains were isolated, belonging to 17 species as shown in Tables I and II.

The most common species were *Aspergillus flavus, A.niger* and *A.nidulans* in both mosquito genera, and the rates of infection (31%) were equal in both genera, too. The mosquitoes species most susceptible to *Aspergillus* colonization were *Culex nigripalpus* and *Aedes fluviatilis*

No difference was observed between the solid media and liquid media used. Both of them presented good results for *Aspergillus* isolation.

Description of the species

Aspergillus aureolatus Munt.-Cvet. And Bata, in *Bull.Inst. et Jardin Botan.Univ. Beograd* n.s. **1**(3): 195-198, 1964.
Illustration: Raper & Fennell (1965)

Table I: Number of strains of *Aspergillus* spp. isolated from *Culex* spp.

Aspergillus isolated/ mosquitoes	**Culex chidester (6)**	**Culex coronator (18)**	**Culex declarator (18)**	**Culex nigripalpus (75)**	**Culex quinquefasciatus (50)**	**Culex saltanensis (35)**	**Culex sp. (19)**	**Total**
A. aureolatus				1				1
A. fischerianus				1	1		1	3
A. flavus	7	2		28	2		6	45
A. heteromorphus				1				1
A. nidulleus		1					1	2
A. niger			4	4	2	1	4	15
A. ochraceus				3	2			5
A. pulvinus			1					1
A. sclerotiorum				1				1
A. sydowi			1	2				3
A. tamarii							1	1
A. terreus				1				1
A. versicolor				1				1
TOTAL	7	3	6	43	7	1	13	80

Culex (Melanconion) sp. (15) - no *Aspergillus* isolated
Culex (Microculex) imitator (6) - no *Aspergillus* isolated
Culex (Microculex) sp. (15) - no *Aspergillus* isolated
( ) = number of mosquitoes

Table II: Number of strains of *Aspergillus* spp. isolated from *Aedes* spp.

Aspergillus isolated/ mosquitoes	Aedes aegypti (87)	Aedes fluviatilis (123)	Aedes scapularis (120)	Aedes terrens (4)	Aedes rhyacophilus (10)	Aedes (Ochlerotatus) sp. (15)	Aedes taeniorhynchus (73)	Total
A.fischerianus				1				1
A.flavus	47	22	16	2		1	2	90
A.fumigatus		1	1	1				3
A.kanagawaensis		1						1
A.niger	4	4	7	1		2		18
A.ochraceus	1	3	2		2			8
A.parasiticus			1					1
A.pulvinus							3	3
A.sclerotiorum		4						4
A.sulphureus		4						4
A.tamarii		1						1
A.terreus		1						1
TOTAL	52	41	27	5	2	3	5	135

( ) = number of mosquitoes

The characteristics shown by the examined culture coincide with the descriptions by Raper & Fennell (1965) and Christensen & States (1982) except for the presence of an amber exudate. This characteristic had been observed before by Moraes *et al.* (1998).
Representative IOC 3993

Habitat and geographical distribution in Brazil: The first isolation of *A. aureolatus* in Brazil was reported by Moraes *et al.* (1998) from the digestive tract of *Panstrongylus megistus* (Triatominae) collected in Rio de Janeiro.

Aspergillus fischerianus Samson & Gams, in *Advances in* Penicillium *and* Aspergillus *systematics*: 39, 1985.
≡ **Aspergillus fischeri** Wehmer, in *Centr.Bakteriol.Parasitenk.* Abt. II, **18**: 390, 1907.
Teleomorph - **Neosartorya fischeri** (Wehmer) Malloch & Cain, in *Can.J.Bot.* **50**: 2621, 1973.

The isolated strains presented the same characteristics as those described by Raper & Fennell (1965), Samson & Pitt (1985) and Kozakiewicz (1989) for *A. fischerianus*.
Representative IOC 3992 and 4008

Habitat and geographical distribution in Brazil: Soil of the states of Amapá, Maranhão, Pernambuco (Batista and coworkers in: Silva & Minter, 1995) and Pará (Dunn *et al.*, 1996). This is a new record of this species on insects.

Aspergillus flavus Link, in *Ges.Naturf. Freunde Berlin, Mag.Neusesten Entdeck Gesammten Naturk.* **3**: 16, 1809.

The isolated strains correspond to the description by Raper & Fennell (1965); Christensen (1981) and Klich & Pitt (1994), except for four isolates that have larger (5-9μm) and more roughened conidia than those described by Klich & Pitt.
Representative IOC 4213, 4214, 4215 and 4216.

Habitat and geographical distribution in Brazil: Soil of Amapá, Maranhão, Rondônia and Roraima (Batista and coworkers, in: Silva & Minter, 1995). In sand from the Ipanema beach, Rio de Janeiro and sand and water of the beach at Boa Viagem, Recife (Sarquis & Oliveira, 1996; Araújo *et al.*, 1992), from air samples in Porto Alegre, Rio Grande do Sul (Homrich, 1961). In excrement of *Bos* sp., *Capra* sp. and *Ovis* sp (Batista et al, 1961, 1967b). In coffee beans, cattle feeds and corn in São Paulo and Minas Gerais (Alves & Castro, 1998; Correa *et al.*, 1997; Castro *et al.*, 1995) and in the digestive tract of *Triatoma infestans, T. sordida, Rhodnius neglectus* and *Panstrongylus megistus* (Moraes *et al.*, 1998).

Aspergillus fumigatus Fresenius, in *Beitr. Mykol.:* 81, 1863.

All isolated strains correspond to the description by Raper & Fennell (1965) and Klich & Pitt (1994), but the strains isolated here from *Aedes* mosquitoes (Tab. II) presented a greater colony growth (80-90mm) than that previously described. This morphological variation has been described by Frisvad & Samson (1990).
Representative IOC 4217

Habitat and geographical distribution in Brazil: In the soil of the states of Amapá, Rondônia, Roraima (Batista and coworkers in: Silva & Minter, 1995), São Paulo and Pará (Dunn *et al.*, 1989). In the sand of the beaches of Ipanema, Rio de Janeiro (Sarquis & Oliveira, 1996) and Boa Viagem, Recife (Araújo *et al.*, 1992). In excrement of *Bos* sp., in Maranhão (Batista *et al.*, 1966), cattle feeds and corn in São Paulo (Correa *et al.*, 1997; Castro *et al.*, 1995) and in Triatomine bugs (Moraes *et al.*, 1998).

Aspergillus heteromorphus Batista & Maia, in *Anais Soc.Biol. Pernambuco* **15**(1): 200-201, 1957.
CYA 25^{0}C: Colony 40mm in diameter, narrowly zonate with surface velvety, first dark olive or green (30F5) becoming dark brownish black (6F8) and reverse yellow becoming dark in age. Stipes (400-)500-600μm, walls smooth, uncolored; vesicles subglobose to globose 48-65μm; Aspergilla biseriate; metulae over the entire vesicle surface, measuring 10-15 x 5-6μm, phialides 8-10 x 5-7μm. Conidia globose most of them smooth, but some echinulate with 3.8μm in

diameter. No sclerotia were found.

MEA 25^{0}C: Colony 45mm in diameter, mycelium inconspicuous or as a white basal felt, zonate, black, reverse uncolored, none sclerotia were found. The microscopic characteristics are smilar to CYA 25^{0}C.

CYA 37^0 C: Colony similar in appearance to CYA 25^{0}C except for the colony diameter (60.8mm).

All isolated strains are typical for the species as described by Raper & Fennell (1965) and Kozakiewicz (1989). Although Batista & Maia (1957) have described the presence of sclerotia, this structure was not observed by Kozakiewicz (1989) nor by us.

Representative IOC 4150

Habitat and geographical distribution in Brazil: This species has only been found in Brazil. Batista & Maia (Silva & Minter, 1995) found it as a contaminant in a culture of *Trichophyton* sp. in Pernambuco, but no description was made. This is the second report of this species in Brazil, and a new record of this species in insects.

Aspergillus kanagawaensis Nehira, in *J. Jap. Bot.* **26**: 109, 1951.

The isolated strain fully corresponded to the description by Raper & Fennell, 1965.

Habitat and geographical distribution in Brazil: The first isolation of *A. kanagawaensis* in Brazil was done by Costa *et al.* (1993) who isolated several representatives from mosquitoes collected in the state of Rondônia but the first description of the species in Brazil was made by Moraes, *et al.* (1998), who isolated it from Triatomine bugs.

Aspergillus nidulans (Eidam) G. Winter, in *Rabenh. Krypt-Fl.*, ed.2, **1(2):** 62.

Teleomorph - **Emericella nidulans** (Eidam)Vuill var. **nidulans**. *C.R.Hebd.Séanc.Acad. Sci. Paris,* 184: 137, 1927.

All isolated strains presented similar characteristics to the species described by Raper & Fennell (1965), Christensen & States (1982) and Klich & Pitt (1994).

Habitat and geographical distribution in Brazil: In the soils of the states of Maranhão, Pernambuco (Batista and coworkers in: Silva & Minter, 1995) and Pará (Dunn *et al.*, 1989). In the sand of Ipanema beach, Rio de Janeiro (Sarquis & Oliveira, 1996) and in the sea water at Boa Viagem, Recife (Araújo *et al.*, 1992). In the digestive tract of both *Triatoma infestans* and *T. pseudomaculata* laboratory reared in Rio de Janeiro (Moraes *et al.*, 1998) and in cattle feeds in São Paulo (Corrêa *et al.*, 1997).

Aspergillus niger van Tighem, in *Ann.Sci.Nat.Bot.*, Ser.5, 8: 240, 1867.

≡ **Sterigmatocystis nigra** van Tieghem, in *Bull.Soc.Botan. France,* 24: 102-103, 1877.

The characteristics of all isolated strains fit with those described by Raper & Fennell (1965), except for seven isolates which presented a yellow-colored radiate reverse, which has been described by Klich & Pitt (1994).

Representative IOC 3998 and 4003

Habitat and geographical distribution in Brazil: Samples of soil from the states of Maranhão, Rondônia, Roraima (Batista *et al.*, 1943, in Silva & Minter, 1995), Pará (Batista *et al.*, 1967; Dunn *et al.*, 1989), Rio de Janeiro (Sarquis & Oliveira, 1996) and Pernambuco (Araújo *et al.*, 1992). It was the most frequently isolated species in air samples from Porto Alegre (Homrich, 1961) and in the digestive tract of Triatomine bugs (Moraes *et al.*, 1998). In sea water of Boa Viagem (Araújo *et al.*, 1992), as well as in several substrates such as animal excrement, human material (Batista and coworkers in: Silva & Minter, 1995), cattle feeds, corn and coffee beans, from different localities in the country (Corrêa *et al.*, 1997; Castro et al., 1997; Alves & Castro, 1998).

Aspergillus ochraceus K.Wilhelm, in *Beitr.Kenntn.* Aspergillus: 66, 1877.

≡ **Aspergillus ochraceo-petaliformis** Batista & Maia, in *An.Soc.Biol. Pernambuco* **15**(1): 217-218, 1957.

Note: Although Samson & Gams (in Samson & Pitt, 1985) had proposed the change of the specific name to *Aspergillus alutaceus*, we agree with Klich & Pitt (1994) in that *A. ochraceus* is such a commonly used name that shall be maintained to promote stability of nomenclature.

The isolated strains corresponded to all the characteristics described by Raper & Fennell (1965), Christensen (1982); Kozakiewicz (1989) and Klich & Pitt (1994).

Habitat and geographical distribution in Brazil: In the soil of the bank of Trombetas river, state of Pará (Dunn *et al.*, 1989). The sand of Ipanema beach, Rio de Janeiro (Sarquis & Oliveira, 1996), as a contaminant of an agar plate in Pernambuco (Batista & Maia, 1957), in the digestive tract of Triatomine bugs (Moraes *et al.*, 1998), cattle feeds (Corrêa *et al.*, 1997), corn (Castro *et al.*, 1995) and coffee beans (Alves & Castro, 1998).

Aspergillus parasiticus Speare in *Bull. Hawaii Sugar Planters' Assoc. Exp. Stn, Pathol. & Physiol. Ser.* **12**: 38, 1912.
Illustration: Klich & Pitt (1994)
CYA 25^{0}C: Colony 51.67mm in diameter, dense, quite low and floccose. Lettuce green (3D7) coloring with uncolored reverse; exudate absent. Conidial heads radiate; stipes (100-)250-500µm, walls finely roughened, uncolored; vesicles spherical 10-20µm. Aspergilla uniseriate; phialides 7-8 x 3-5 µm. Conidia globose, 2.7-3µm in diameter, rough-walled, slightly pigmented.
MEA 25^{0}C: colony similar in appearance to CYA 25^{0}C except to colony diameter in 60.88mm
CYA 37^{0}C: colony 70.43mm in diameter, dense and floccose. Linoleum brown (5E7) with brown reverse; exudate absent. Conidial heads radiate ; stipes 100-250µm, walls finely roughened, uncolored; vesicles slightly elongate 10-20µm. Aspergilla uniseriate, phialides 6-7 x 2-4µm. Conidia globose, 2.5-3µm in diameter, rough-walled, slightly colored.

The isolated strain from *Aedes scapularis* presented similar characteristics to the species described by Klich & Pitt, 1994 except for its color [lettuce green (3D7)] and larger colony growth.

Habitat and geographical distribution in Brazil: In the soil of the states of Pará and Rio de Janeiro (Dunn *et al.*, 1989; Sarquis & Oliveira, 1996) and in cattle feeds in São Paulo (Corrêa *et al.*, 1997). These previous reports did not provide a description of the isolates.

Aspergillus pulvinus Kwon-Chung & Fennell, in *The Genus Aspergillus*, p.45, 1965.
Illustration: Raper & Fennell (1965)

Raper & Fennell (1965) and Kozakiewicz (1989) described this species with an abundant brown exudate. Our isolate did not have this kind of exudate; this coincides with the observations made by Klich & Pitt (1994) and Moraes *et al.* (1998).
Representative IOC 3957

Habitat and geographical distribution in Brazil: This species was first recorded in Brazil by Moraes *et al.* (1998) from the digestive tract of *Triatoma brasiliensis*.

Aspergillus sclerotiorum Huber, in *Phytopathol.* **23**: 306, 1933.

The isolates coincide in all characteristics with the description made by Raper & Fennell (1965); Christensen (1982) and Klich & Pitt (1994).

Habitat and geographical distribution in Brazil: In the soil of the states of Maranhão, Pernambuco, Rondônia (Batista *et al.* in: Silva & Minter, 1995) and Rio de Janeiro (Sarquis & Oliveira, 1996), in the sea water at Boa Viagem beach, Recife (Araújo *et al.*, 1992) and in Triatomine bugs (Moraes *et al.*, 1998).

Aspergillus sulphureus (Fresenius)Wehmer, in *Mém. Soc. Phys. Genéve,* **33**(2): 113. 1901.

All isolated strains had the same characteristics of the species as described by Christensen (1982) except for 2 strains which had smaller vesicles (8-9µm). This characteristic has been mentioned before by Moraes, *et al.* (1998).
Representative IOC 4001

Habitat and geographical distribution in Brazil: In the soil of the states of Maranhão, Pernambuco, Rondônia (Batista and coworkers in: Silva & Minter, 1995) and Rio de Janeiro (Sarquis & Oliveira, 1996). In digestive tract of Triatomine bugs (Moraes *et al.*, 1998).

Aspergillus sydowii (Bainier & Sartory)Thom & Church, in *Aspergilli*, 147, 1926.
≡ **Sterigmatocystis sydowii** Bainier & Sartory, in *Ann.Mycol.* **11**: 25-29, 1913.

All the isolates presented vesicles smaller (7-11µm) than those described by Raper & Fennell (1965). The morphological studies of *A. sydowii* performed by Klich & Pitt (1994) and Kozakiewicz (1989), showed variation in the range of vesicles. No hulle cells were found.

Representative IOC 3996 and 4000

Habitat and geographical distribution in Brazil: In the soil of the states of Maranhão, Rondônia, (Batista *et al.*, 1964, 1966) and Pernambuco (Araújo *et al.*, 1992). In the digestive tract of *Triatoma brasiliensis, Rhodnius prolixus* and *Panstrongylus megistus* (Moraes *et al.*, 1998).

Aspergillus tamarii Kita, in *Cenbl. Bakt. Parasitkde,* Abt.2, **37**: 433, 1913.

CYA: Colony 4-7cm, azonate, yellowish brown (5D8) with uncolored reverse. No exudate. Conidial heads yellowish brown radiate. Conidiophores long, uncolored, roughened all length, more than 300-1900µm x 12-20µm. Vesicles globose with uniseriate and bisseriate phialids. Small heads with uniseriate phialids, big heads with bisseriate ones. Conidia globose, roughened 4-7µm.

ME: Colony 6cm, fairly zonate. Yellowish brown (5D8) with uncolored reverse. No exudate. Condial heads yellowish radiate. Conidiophores bigger than in CYA more than 2cm and roughened. Vesicles subglobose to globose with uni or bisseriate phialids. Conidia pyriform to globose, roughened, 5-8µm.

Representative IOC 4005

Raper & Fennell (1965) described the presence of exudate in some strains of *A. tamarii,* which was not found in our isolate.

Habitat and geographical distribution in Brazil: In the soil of the states of Rondônia (Batista *et al.*, in Silva & Minter, 1995) and Pernambuco (Araújo *et al.*, 1992). In air samples and excrement of *Bos* sp from Maranhão (Batista *et al.*, 1964) and in the sea water of Boa Viagem beach, Recife (Araújo *et al.*, 1992). The isolates reported in the above mentioned papers were not described.

Aspergillus terreus Thom, in *Am. J. Bot.* **5**: 85, 1918.

The morphological aspects of the isolated strain correspond to those described by Raper & Fennell (1965), Kozakiewicz (1989) and Klich & Pitt (1994).

Representative IOC 4007

Habitat and geographical distribution in Brazil: In the soil of the states of Roraima (Batista *et al.*, in Silva & Minter, 1995), Pernambuco (Araújo *et al.*, 1992) and Rio de Janeiro (Sarquis & Oliveira, 1996). As a contaminant in the state of Amapá and Pernambuco (Batista *et al.* in Silva & Minter, 1995). In excrement of *Bos* sp. and *Equus* sp. in Maranhão and Rondônia (Batista *et al.*, 1961) and in sea water of Boa Viagem (Araújo *et al.*, 1992).

Aspergillus versicolor (Vuill.)Tiraboshi, in *Ann.Bot. (Roma)* **7**: 9, 1908.
≡ **Sterigmatocystis versicolor** Vuillmin, B.Mirsky, *Thése de Médecine*, Nanly, **27**: 15, 1903.

All studied strains coincide with the description by Raper & Fennell (1965), Kozakiewicz (1989) and Klich & Pitt (1994).

Representative IOC 3997

Habitat and geographical distribution in Brazil: In the soil of the states of Amapá, Maranhão, Rondônia (Batista and coworkers in: Silva & Minter, 1995) Pará (Dunn *et al.*, 1989) and Rio de Janeiro (Sarquis & Oliveira, 1996). In the sea water from the beach of Boa Viagem, Recife (Araújo *et al.*, 1992). In the atmosphere in Porto Alegre (Homrich, 1961) as well as in several substrates as such animal excrements, human material, gills of native fishes in Pernambuco (Batista *et al.*, 1955, 1965, 1966) and Triatomine bugs (Moraes *et al.*, 1998).

General conclusion

The mosquitoes studied are principally considered domestic because their geo-substrate consists of human population centers (cities and towns), mainly in coastal areas or along major river banks, generally in moist tropical areas at low elevations (Rey, 1991). Many of the fungi isolated can be found in these habitats, with the exception of *A.pulvinus* and *A.tamarii*, which are usually isolated from insects.

There are few references in the literature on the isolation of fungus from mosquitoes (Culicidae) and very few is known about the host-fungus relationship in this insects. All *Aspergillus* species isolated from mosquitoes reported herein are new records for species of *Culex* and *Aedes* in Brazil, although these fungus are widely found in nature.

Aspergillus flavus, A. niger and *A. ochraceus* were the most commonly isolated species (Tables I and II) which have been isolated from insects belonging to different orders (Batra *et al.*, 1973, Dubrovskiy & Rybal Chenko, 1993, Moraes *et al.*, 1998) and regarded as entomopathogenic (Roberts & Humber, 1981, Alves, 1986). *Aspergillus fischerianus* and *A. heteromorphus,* have never been reported as associated with insects.

Acknowledgments

We would like to thank Dr. Leonidas Deane (in memoriam) for the coordination of this project; Márcia G. Costa, Monique Motta and Teresa F. Silva from the Entomology Departament - FIOCRUZ for the help in the capture and identification of the mosquito species; Dr. Maren A. Klich for helpful suggestions when acting as presubmission reviewer and to TDR/WHO for financial support for the project.

The authors dedicate this paper in honor of the Oswaldo Cruz Institute, on occasion of the centenary of its foundation, May 25th 1900.

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MYCOTAXON

Volume LXXVIII, pp.423-434 April-June 2001

VARIABILITY OF HYPHODERMA SETIGERUM (CORTICIACEAE S.L., BASIDIOMYCETES) IN BELARUS AND NORTHWEST RUSSIA

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Abstract: The general morphology and spore variability of *Hyphoderma setigerum* are discussed. The herbarium material from Belarus and northwest Russia (Leningrad region) has been involved in the study to build a generalized morphological description of the species.

Key words: Corticioid fungi, Basidioma morphology, Cystidia forms, Spore size, Spore quotient.

The corticioid fungus *Hyphoderma setigerum* (Fr. : Fr.) Donk is a widespread polytrophic saprobe, associated presumably with deciduous wood. The species is characterized by remarkable fruitbody variability (Eriksson, Ryvarden, 1975; Jülich, 1984; Domański, 1988; Hansen, Knudsen, 1997), and its morphological concept is sufficiently complex issue. As neutral "type" of the species some authors (Nikolayeva, 1961) consider an abstract setigerous grandinioid fungus, however in many cases such concept will be not applicable. In our opinion, the principal diagnostic characters are an association of clamped cystidia with diversely shaped hymenial warts, while the limits of basidioma variability are principally extensive. The purpose of this work is to describe the variability in *H. setigerum* as known from the north-central Europe.

The material from Belarus and northwest Russia (mainly Leningrad region) was studied. The vouchers taken in account are kept in the herbaria of V.F. Kuprevich Institute of Experimental Botany, Minsk (MSK, Fungi) and V.L. Komarov Botanical Institute, St. Petersburg (LE). Specimens from Belarus (MSK) have mainly been collected by E.O. Yurchenko. Collections from Russia were deposited by T.L. Nikolayeva and I.V. Zmitrovich.

The data on geography and hosts of the species in Belarus are presented in Table 1. When the substrate was not reliable identified the host name is enclosed in brackets.

Table 1. Substrates and spore variability in *H. setigerum* (Belarusian material studied). Spore sizes are given as means of 30 measured spores and SD is given in parenthesis.

			Spore size and shape:	
MSK no.	**District of Belarus**	**Substrate (host)**	**Length × width (μm)**	**Length /width**
3812a	Minsk	(*Fraxinus pennsylvanica*)	7.7 (1.6) × 3.3 (0.3)	2.4
3812b	Minsk	(*Fraxinus pennsylvanica*)	7.5 (1.6) × 3.0 (0.4)	2.5
3870	Pruzhany	(*Quercus robur*)	7.5 (1.0) × 2.8 (0.4)	2.7
3871	Mazyr	*Alnus glutinosa*	8.9 (1.6) × 3.1 (0.3)	2.9
3872	Mazyr	*Alnus glutinosa*	10.55(1.3) × 3.55 (0.4)	3.0
4095	Svislach	*Quercus robur*	10.2 (1.1) × 3.3 (0.4)	3.1
4131	Lepel'	*Salix pentandra*	8.8 (1.4) × 3.3 (0.4)	2.7
4321	Lepel'	*Alnus glutinosa*	8.5 (1.6) × 2.9 (0.5)	3.0
4426	Lahoisk	*Sorbus aucuparia*	10.6 (1.5) × 3.7 (0.5)	2.9
4431a	Hlubokaye	*Sorbus aucuparia*	8.2 (1.4) × 3.25 (0.4)	2.6
4431b	Hlubokaye	*Sorbus aucuparia*	8.0 (1.4) × 3.2 (0.4)	2.5
4576	Petrykau	*Pinus sylvestris*	8.1 (1.4) × 3.7 (0.6)	2.2
4675	Pukhavichy	*Sorbus aucuparia*	8.7 (1.5) × 3.4 (0.5)	2.6
4700	Minsk	*Pinus sylvestris*	8.7 (1.8) × 3.8 (1.0)	2.3
4733	Lepel'	*Betula pubescens*	8.3 (1.6) × 3.0 (0.4)	2.8
4843	Lepel'	*Alnus glutinosa*	8.3 (1.2) × 2.8 (0.4)	3.0
4866	Lepel'	*Alnus glutinosa*	9.2 (1.6) × 3.0 (0.4)	3.1
4975	Rechytsa	*Malus sylvestris*	8.1 (1.3) × 2.9 (0.4)	2.8
4976	Minsk	*Cerasus vulgaris*	8.8 (1.2) × 3.2 (0.4)	2.8
4977	Minsk	(*Quercus robur*)	8.7 (1.4) × 3.0 (0.4)	2.9
4978	Minsk	*Alnus glutinosa*	7.7 (1.2) × 3.6 (0.8)	2.2
4979	Minsk	*Cerasus vulgaris*	10.0 (1.3) × 3.5 (0.2)	2.9
4980	Khoiniki	*Malus domestica*	7.8 (1.2) × 3.3 (0.4)	2.4
4981a	Grodna	*Betula pendula*	7.3 (0.9) × 2.7 (0.2)	2.7
4981b	Grodna	*Betula pendula*	8.8 (1.8) × 2.8 (0.3)	3.2
4983	Lahoisk	*Malus sylvestris*	8.4 (1.6) × 3.0 (0.5)	2.8
4984	Minsk	*Malus sylvestris*	11.1 (1.8) × 3.8 (0.3)	3.0

4985	Pukhavichy	*Malus domestica*	9.6 (1.5) × 3.3 (0.4)	2.9
4986	Lahoisk	*Malus sylvestris*	8.7 (1.7) × 3.5 (0.3)	2.5
4987	Minsk	*Sorbus aucuparia*	9.8 (1.9) × 3.6 (0.3)	2.7
4988	Minsk	*Cerasus vulgaris*	9.0 (1.6) × 3.6 (0.4)	2.5
4989	Grodna	*Tilia cordata*	11.2 (1.6) × 3.6 (0.5)	3.1
4991	Asipovichy	*Alnus glutinosa*	8.9 (1.8) × 2.9 (0.5)	3.2
4992	Asipovichy	*Alnus glutinosa*	9.0 (1.9) × 3.1 (0.3)	3.0
5076	Lepel'	*Alnus glutinosa*	9.2 (1.7) × 3.4 (0.4)	2.7
5077	Lepel'	*Populus tremula*	9.9 (1.4) × 3.6 (0.5)	2.8
5103	Dzyarzhynsk	*Betula pendula*	7.6 (1.3) × 2.9 (0.3)	2.7

Substrate. The fungus develops both on bark and wood periphery of different deciduous trees, rarely on conifers (*Picea abies*, *Pinus sylvestris*). Less frequent substrates recorded from the area are dead lichen thalli (*Hypogymnia physodes*, MSK 4417, LE 201726; *Parmelia omphalodes*, LE 202182), pyrenomycete stromata (*Daldinia concentrica*, LE 206856), small plant debris, and burnt wood (conifer twigs, LE 206729), whereas the commonest one is *Alnus* wood. The dispersal of the species from nemoral to taiga vegetation zones is probably associated with alder rich vegetation.

Macromorphology. The fungus forms resupinate fructifications of diverse morphology, and its field identification in many cases is problematic. Young basidiomata are as a rule arachnoid-farinaceous, then continuous, on decorticating wood typically effused. When found on the bark, basidiomata may arise from lenticells as initial warts, then orbicular and confluent, repeating or not the relief of substrate, reaching 5 × 15 cm and more in extent, becoming deeply and densely cracked with age. Consistency mainly soft ceraceous to slightly cartilaginous, in some cases floccose and reminding of *Hyphodontia* species. Thickness varies from 0.07 - 0.3 to 1 - 5 mm, sometimes even thicker (see below). Thicker parts as a rule occupy depressions in the substrate and include particles from the bark. Thickening of orbicular fruitbodies sometimes lead to semiglobose formation. Hymenial surface is initially farinaceous to granulose but becomes tuberculate, warted, or toothed with age (teeth mostly 0.25 - 1.5 mm diam and 0.2 - 1 mm high). Parmasto (1969) mentioned, that teeth in some specimens may be furnished by dendroid outgrowths (in our collections this phenomenon was observed too, e.g. LE 209772). Color varies from pure white to cream, yellow, isabelline or even ochraceous, in some cases a weak pinkish tinge was present. Margin thinning out or bolster-like, arachnoid to continuous and thickening, abrupt, in most cases adnate, but in some old fructifications loosely attached.

Corticioid and grandinioid (with granulose hymenium) forms dominates in the investigated area, whereas odontioid and raduloid ones are less frequently met with (in North America the situation seems to be reverse - see Miller and Boyle, 1943). The data on some forms with rather deviating hymenial configuration are given in Table 2.

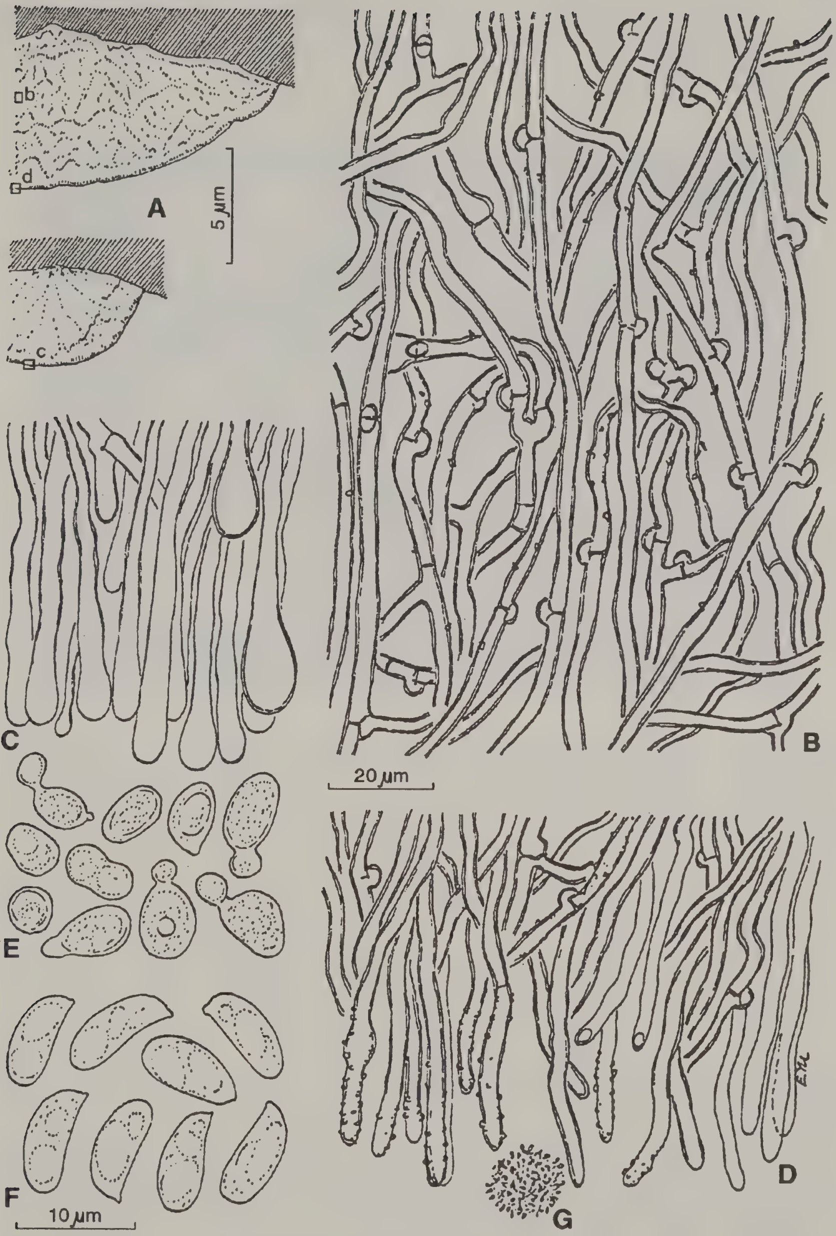
Table 2. Substrates and spore variability in some deviating growth forms of *H. setigerum* (Russian material studied)

			Spore size and shape	
Growth form of basidiomata	**LE No.**	**Substrate**	**Length × width (µm)**	**Spore quotient**
Odontioid				
« semiglobose	206586	*Alnus incana*	7.5-12.0×2.8-4.5	2.4
« with dendroid hyphae in teeth	209772	*Alnus incana*	7.5-12.5×3-4	2.8
« effused with a striking central wart	206847	*Betula* sp.	7.0-11.2×2.8-3.5	2.6
Raduloid	209704	*Alnus incana*	7.5-12.5×3.2-4.5	2.8
« with bolster-like sterile margin	202106	*Alnus incana*	7.5-10×2.5-4.3	2.5

Concerning the thickness of fruiting bodies we made surprising observations. We found specimens with conspicuous cushion-like basidiomata, up to 7-10 mm thick. Such findings seem to have been observed earlier, because Fries (1838, 1874) mentions that basidiomata in *Kneiffia setigera* may be very thick, «... *in statu perfectissimo hemisphaericas*...» and also «*Specimina maxima Pomi magnitudie*...» (dimensions were not indicated). Regardless that there are no principal limits for basidiomata growth in fungi, such thickened fruitbodies are certainly rare in nature.

The specimen with thickened basidiomata from Belarus (MSK 4431b, Fig. 1) was found on a fallen decayed trunk of *Sorbus aucuparia*, and thickened basidiomata grown jointly with a typical, thin one (MSK 4431a). They are resupinate, cushion-like, 2.5-5 mm thick in average, up to 7 mm thick, 5-7 cm in extent, pale coloured, with rather loose, but elastic (when fresh) consistency. Hymenial surface seems not to be quite mature, uneven, lacunose-tuberculate with minute ridges formed by hyphal fascicles or even and partly powdery due to crystalline masses. The specimen collected in St. Petersburg growing on the stump of *Alnus incana* (LE 206586, Fig. 2) reach a thickness of 10 mm. Its cross-section is clearly semiglobose, whereas the hymenophore is oblong, with thin, sterile margin (Fig. 2 A). Surface, like the Belarusian specimen, is in most parts uneven, lacunose, but so far as basidioma is mature, the odontioid processes are more expressed. In living state aculei in the specimen reached 4 mm.

Thus, we have a rare growth form being revealed from time by time by independent investigators (see Fries, 1838; Scheremeteva, 1908). The possible reason stimulating such forms could be breakings of the normal growth conditions (change of substrate orientation), or simply interpreted as an age


b
d
A
5 µm
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C
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E
F
10 µm
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Figure 1. *Hyphoderma setigerum* (MSK 4431b). A-D, sections through basidiomata. E, budding bodies. F, basidiospores. G, crystalline mass. Drawings by E.O. Yurchenko.

state. Specimens with unusually thickened fruitbodies recorded by the authors were mainly collected at the end of the vegetation period (October - November).

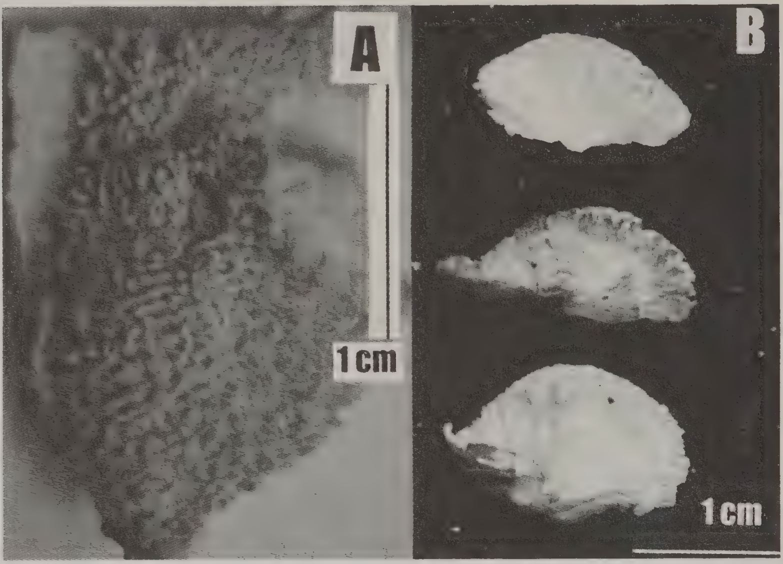

Figure 2. Thickened basidiomata of *Hyphoderma setigerum* (LE 206586), collected in St. Petersburg (05.10.1997, Piskaryovskii forest park) from decayed stump of *Alnus incana*. A, odontioid basidioma with sterile edging, B, basidioma in cross-sections (photo I.V. Zmitrovich).

Hyphae (Fig. 1 B). Hyphae are distinct, 2 - 5.5 (6) µm wide, thin- to somewhat thick-walled, fibulate, with characteristic hyphodermoid ramifications, vertically arranged in subhymenium and more horizontal in subicular part; smooth or encrusted, hyaline or subhyaline, even, rarely with ampullate (MSK 4976) or irregular swellings up to 8.5 - 10 µm in diam; sometimes with adventitious septa. Walls up to 0.8 - 1 µm thick, although sometimes reaching 2 µm (MSK 4983). As a rule in young or weakly developed basidiomata all the hyphae are thin-walled. Subiculum loose or tightly packed.

Septocystidia (Fig. 3 A - C, F - H, J - N). The most peculiar and characteristic element of high diagnostic value. They are pronounced, rare in young basidiomata, as a rule well developed and abundant in mature ones, associated mainly with apices of warts, teeth or other protuberances, 55 - 185 (280) × 5.5 - 12 (14) µm, immersed or protruding to 55 - 170 µm, walls up to 2 - 2.5 µm thick, sometimes seemingly layered (MSK 4131). Typical cystidia

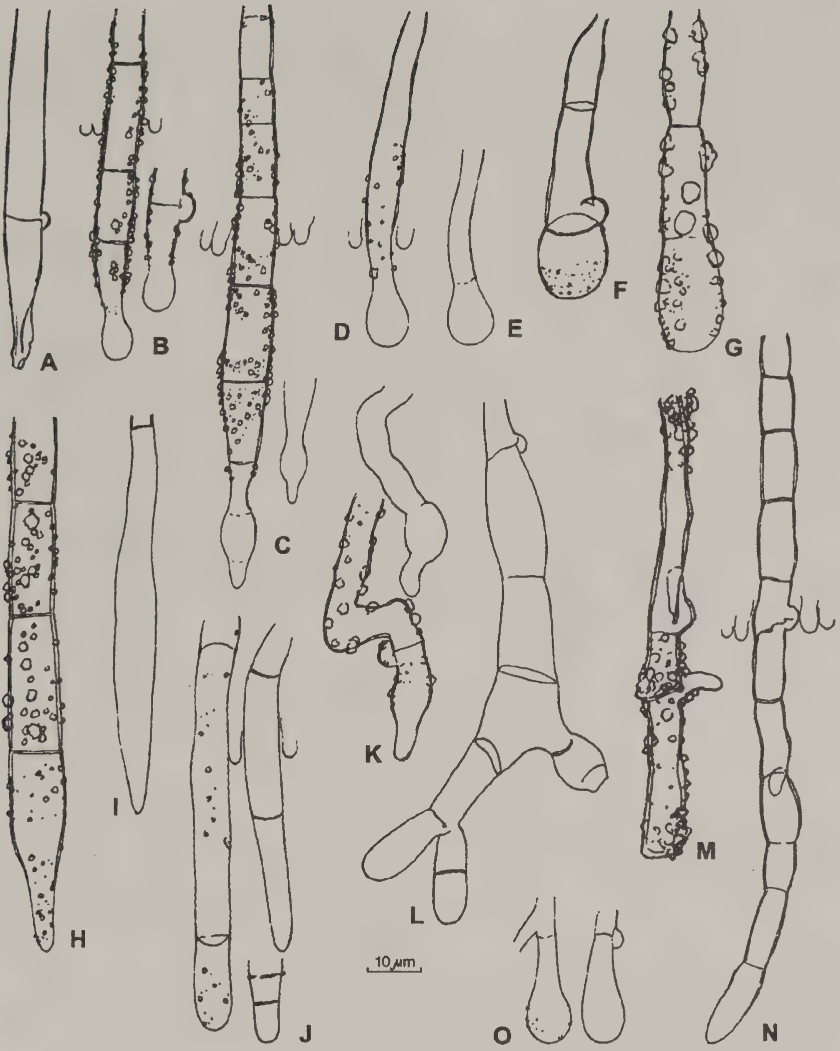

Figure 3. Cystidia (A-N) and basidioles (O) of *Hyphoderma setigerum*. A, cylindrical with wrinkled tip (MSK 4986). B, capitate (MSK 3872). C, clampless capitate, with spout-like tip (MSK 3872). D and E, capitate aseptate (D - MSK 4985, E - MSK 4988). F and G, with widened apical part (F - MSK 4131, G - MSK 4843). H, clampless, narrowed at the tip (MSK 4866). I, fusiform smooth (MSK 4866). J, with adventitious septa (MSK 3870). K, distorted (MSK 4843). L, branched (MSK 3870). M, branched at clamp (MSK 4984). N, with many short-celled segments (MSK 4991). O, clavate basidioles (MSK 4988).

are cylindrical and unbranched with truncate apices and clamped septa, but variation occur, namely: 1) with clampless septa, 2) aseptate, 3) with capitate thin-walled tip, 4) apically widened or swollen (MSK 3872), 5) with inflations in other parts, 6) tapering to the apex, 7) with many short-celled segments, 8) branched (MSK 3870).

The content is hyaline to yellowish or slightly greenish, refractive or not, homogeneous or granular.

The encrustation if present varies from poor to abundant, consists of minute or big double-pyramidal crystals (0.3 - 7 µm long, Fig. 3 F, G). Cystidial apices as a rule smooth or less encrusted.

Basidia and basidioles. Basidia in the fungus are of typical hyphodermoid appearance, subclavate, with characteristic median constriction and 4 long sterigmata, 25 - 35 (45) × 5 - 6 (7) µm (sterigmata reaching 9.5 µm length), arranged in a palisade or sometimes a more loose structure. Hyaline to yellowish ovoid or short-clavate structures 7 - 9 µm wide and *ca* 20 µm long present in some specimens (Fig. 3 O), which probably are young stages of either basidia or cystidia.

Spores (Figs. 1 F, 4). Spore shape varies from ovoid to ellipsoid and cylindrical, adaxially flattened and often slightly curved. Apiculus short to prominent, sometimes not visible. Surface smooth, in one specimen (MSK 4989) with adhered granules.

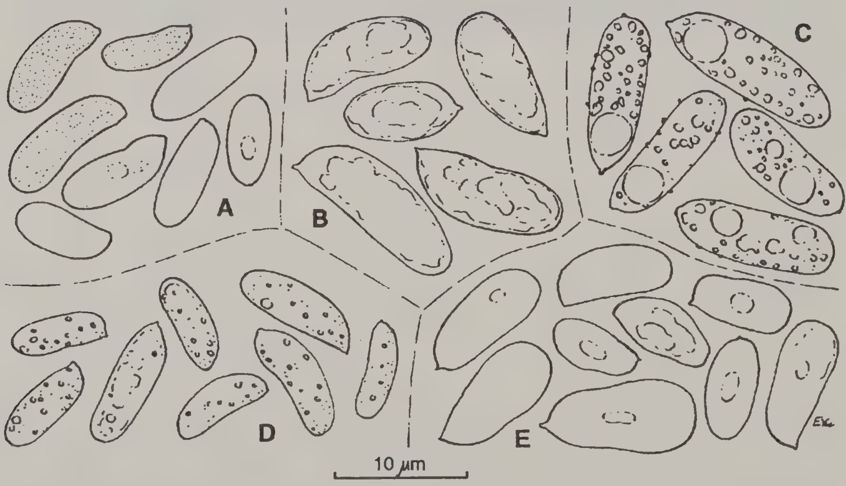

Figure 4. Spores of *Hyphoderma setigerum*. A, MSK 4870. B, MSK 4987. C, MSK 4989. D, MSK 4733. E, MSK 4700.

Spore wall from very to moderately thin, forming distinct outline. Content hyaline or subhyaline (seemingly greenish), refractive or not, as a rule granular.

Data on spore sizes are presented in Table 1 (mean length and width, standard deviation, and mean length/width ratio). For each specimen 30 spores were measured. Spores sizes varies in limits 5.5 - 14 × 2.0 - 5.5 µm with the marginal mean values for our specimens 7.3 - 11.2 × 2.7 - 3.8 µm. Spore quotient varies considerably: from 1.2 to 5.0, its mean values are from 2.2 to 3.2. The generalized mean spore size for Belarusian material is 8.85 × 3.25 µm, and spore quotient is 2.76. We observed certain dependence of spore length and width from the type of substrate: fallen or erect branches and trunks. The basidiomata growing on vertical trunks and still-attached branches have mostly bigger spores than basidiomata on fallen wood (Fig. 5). Mean spore sizes are 9.4 × 3.4 for basidiomata in exposed position versus 8.7 × 3.2 for basidiomata in close contact with the ground.

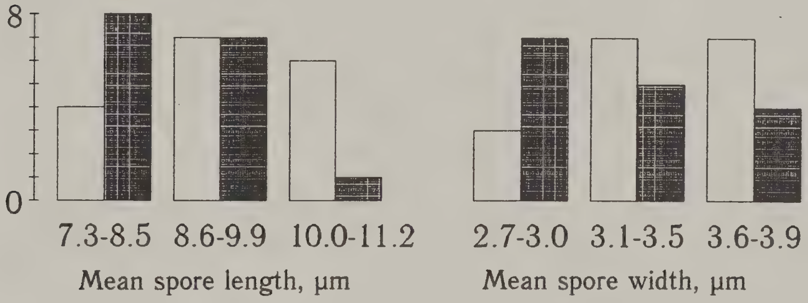

Figure 5. Number of specimens of *Hyphoderma setigerum* with mean spore length and width belonged to one of three classes, with basidiomata growing on still-attached branches and vertical trunks (white rectangles), and on fallen branches and trunks (gray rectangles).

Any dependence of spore size and shape from both the host species and the type of host tissue were not found. An exception is rather short and wide spores of specimens from *Pinus sylvestris* (length/width = 2.2 and 2.3).

A deviating form is represented by MSK 4978 (Fig. 6) with small ovoid or ellipsoid spores (7.7 × 3.5 µm in average), very few septocystidia, and well visible basal layer up to 90 µm thick. It is remarkable, that some spores of this specimen are subglobose (length/width = 1.2 - 1.3), subhymenium is richly encrusted, cystidia are weakly projecting and sparse, the hymenial palisade is very dense.

Other structures. Rounded or slightly angular bodies 3.7 - 18.5 × 3.5 - 11 µm with some oily hyaline to yellowish contents (Fig. 6 B) were observed in a number of specimens. They are dispersed or aggregated in subiculum, mainly near substrate, resembling a parasitic fungus. In one thickened specimen (cited above) was found subhyaline yeast-like structures 3 - 9.5 (15) × 3 - 5.5 µm with contents and refraction resemble those of basidiospores (Fig. 1 E). They seem to be budding, in some places forming large assemblages. The functional value of both types of structures remains unknown for the authors.

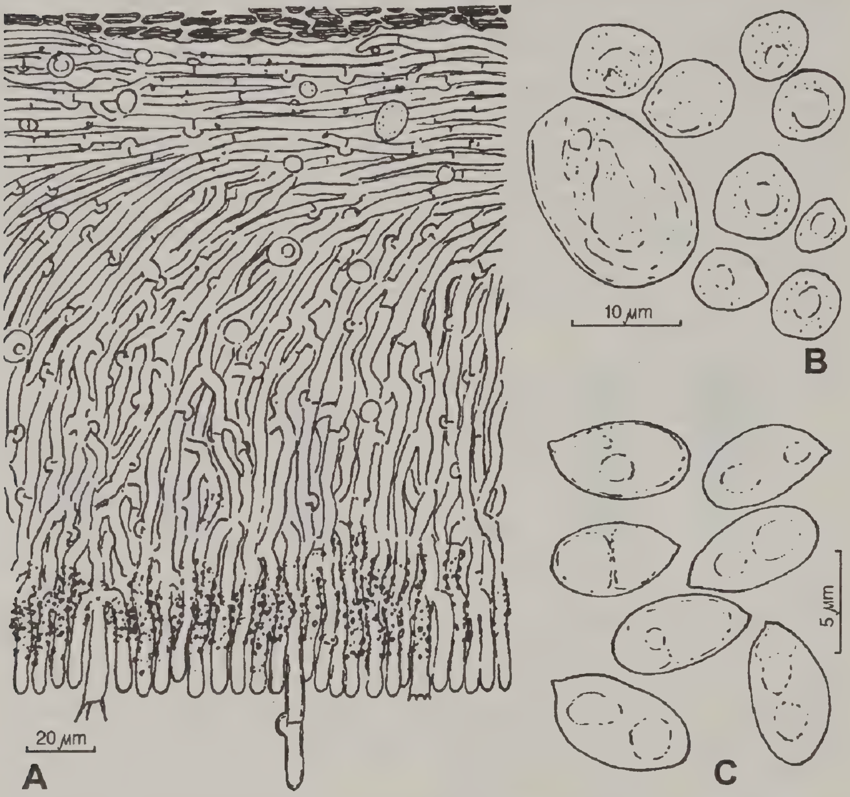

Figure 6. *Hyphoderma setigerum* (MSK 4978). A, vertical section of basidioma with basal layer. B, rounded bodies from subiculum. C, spores.

Considering the here added information on basidiome morphology the elaborated diagnosis of the species may be presented as follows.

Hyphoderma setigerum (Fr. : Fr.) Donk, Fungus 27: 15, 1957. - *Thelephora setigera* Fr. : Fr., 1828. - *Kneiffia setigera* (Fr. : Fr.) Fr., 1838. - *Peniophora setigera* (Fr. : Fr.) Höhn. et Litsch., 1906. - *Odontia setigera* (Fr.: Fr.) L.W. Mill., 1934; *Hydnum cristulatum* Fr. : Fr., 1821; *Thelephora aspera* Pers., 1822 non Fr.; *Hyphoderma spiculosum* Wallr., 1833; *Corticium myxosporum* P. Karst., 1882.; *Corticium latitans* P. Karst., 1888; *Odontia acerina* Peck, 1901; *Peniophora subtestacea* Litsch., 1928.

Basidiomata adnate, effused or orbicular with central wart, firstly arachnoid, then thickening, up to 15 - 20 cm in extent and 10 mm thick, ceraceous to floccose, often cracking, white to ochraceous. Margin sterile, arachnoid to bolster-like, white, then darkening. Hymenium smooth (farinaceous under lens) or toothed. Teeth 4 mm or less in length, conical to dendroid, blunt, sometimes crowded, hispid at the apex. Hyphae 2 - 6 (10) μm in diam, clamped, with age moderately thick-walled, smooth or with scattered encrustation, loosely arranged. Cystidia 30 - 280 × 5.5 - 14 μm, cylindrical, sometimes tapering or branched, as a rule septate with clamp connections, projecting on 10 - 170 μm mostly near the apex of hymenial warts, at first naked, becoming encrusted with coarse crystals. Basidia 25 - 45 × 5 - 7 μm, subclavate, constricted, with 4 sterigmata (reached to 9.5 μm in length), hyaline; sometimes together with ovoid or short-clavate basidioles 15 - 25 × 7 - 9 μm. Spores 5.5 - 14 × 2.0 - 5.5 μm, mostly 7 - 11 × 3 - 4 μm, ovoid to cylindrical, slightly curved or at least clearly depressed, smooth, hyaline, as a rule granular and guttulate.

On bark or wood of alder and many other deciduous, rarely coniferous trees, dead lichen thalli, old pyrenomycete stromata, plant debris and burnt pieces. Associated with a white rot. Grows from June to November. Common and widely distributed in North-Central Europe. Circumglobal species.

Acknowledgement

We are grateful to Dr. N. Hallenberg, Department of Systematic Botany, University of Göteborg, Sweden, for critical review of the manuscript.

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MYCOTAXON

Volume LXXVIII, pp. 435-438 April-June 2001

DIDYMOSPHAERELLA YUCCAE sp. nov.

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Abstract: *Didymosphaerella yuccae*, the third species of the genus, is described. This genus has been utilized by Barr for the didymosporous fungi belonging in the newly delimited family, Montagnulaceae.

Keywords: *Didymosphaeria, Montagnula,* systematics

INTRODUCTION

During the study of fungi on dead leaves of *Yucca* L., a distinctive fungus with bitunicate asci and large, intensely colored, 1-septate ascospores was collected on several occasions. In the past this fungus might have been considered a species of *Didymosphaeria* Fuckel, but the presence of pseudoparaphyses made such placement impossible. The fungus could not correctly or reasonably be placed in any existing family or genus. Barr's (2001) description of the new family, Montagnulaceae, and her utilization of *Didymosphaerella* Cooke for didymosporous members of that family allows proper placement of the fungus.

TAXONOMY

Didymosphaerella yuccae A. W. Ramaley et M. E. Barr *sp. nov.* FIG. 1-5

Ascomata immersa, subepidermalia, globosa vel sphaeroidea, 390-650 μm lata, usque ad 650 μm elata papilla inclusa. Papilla 100-200 μm elata, ostiolum pseudoparaphysibus et periphysibus repletum, extensibus trans epidermidem hospitis. Peridium 25-50 μm latum, ex 5-8 stratis cellularum brunnearum, parum compressarum pseudoparenchymatarum compositum, saepe brunnearum dilutarum prope basin, strata interiore brunnea plus diluta, 2-3 strata hyalina additicia prope interior; hyphae saepe brunneae dilutae ex peridio in substratum. Asci bitunicati, fissitunicati, cylindrici, numerosi, 190-250 (-320) x 22-25 (-29) μm. Pseudoparaphyses numerosae, cellulosae, ca 2.5-5.0 μm diam., cellulae numerosae ca. 30 μm longae. Ascosporae extremis obtuse rotundatis, 26.5-35 (-40) x 15-20 (-21) μm, hemispora intera plerumque aliquantum brevior et angustior quam hemispora supera, 1-septatae, septa constricta, rufobrunneae, verrucolosae, crassiparietes, in aqua tunica lata, hyalina, circumcinctae, in asco uniseriatae superpositae.

HOLOTYPUS: "U.S.A. TEXAS: Culberson Co., Guadalupe Mountains National Park, 3.7 miles from the highway on Williams Ranch Road, 23 October 1995," *ex foliis emortuis Yucca torreyi(?)* Shafer, a *Annette Ramaley 9536A lectus in BPI sub n. 747565 depositus.* ISOTYPUS UC 1512976.

Ascomata (FIG. 1) immersed, subepidermal, visible from above as a dark ring ca 50 μm broad and 300 μm diam. although the dimensions and intensity of the ring are variable, globose or sphaeroid, 390-650 μm broad, up to 650 μm tall including the papilla. Papilla 100-200 μm tall, ostiole stuffed with pseudoparaphyses and periphyses which extend through and somewhat beyond the ruptured host epidermis. Peridium (FIG. 2) rather soft, 25-50 μm thick, composed of 5-8 layers of brown, somewhat compressed, pseudoparenchymatous cells, often rather pale brown toward the base, the interior layers progressively lighter brown, an additional 2-3 layers of hyaline cells toward the interior; abundant, often rather pale brown hyphae extending from the peridium into the host tissues. *Asci* (FIG. 3) bitunicate, fissitunicate, cylindric, numerous, 190-250 (-320) x 22-25 (-29) μm. Pseudoparaphyses numerous, cellular, ca 2.5-5.0 μm diam., many cells ca 30 μm long. *Ascospores* (FIG. 4) bluntly rounded at both ends, the lower cell mostly somewhat shorter and narrower than the upper cell, 26.5-35 (-40) x 15-20 (-21) μm, 1-septate, constricted at the septum, red brown, verruculose, thick walled, surrounded by a broad sheath in water (FIG. 5), each cell with one large central guttule, overlapping uniseriate in the ascus.

DISCUSSION

This fungus is among the diverse representatives that would have been placed in *Didymosphaeria* prior to understanding of the differences in origin of the hamathecium of the Melanommatales, which contain tinophyses, and the Pleosporales, which contain pseudoparaphyses. Aptroot's monograph of *Didymosphaeria* (1995a) dramatically limited the number of species accepted in that genus, and some of the excluded species were then redisposed (Aptroot 1995b). Although the name originally applied to dictyosporous representatives, *Montagnula* Berl. was used to accommodate many of the didymosporous Pleosporalean representatives. *Didymosphaerella yuccae* would have been considered a species of *Montagnula* in this rearrangement. Barr (2001) removed *Montagnula*, with dictyospores, and *Kalmusia* Niessl, with phragmospores, from the Phaeosphaeriaceae to a new family, the Montagnulaceae. She also lectotypified *Didymosphaerella*, expanded Cooke's 3-word description of the genus, and utilized the name for didymosporous representatives of this family.

The large papillate ascomata, numerous pseudoparaphyses, and intensely colored, thick-walled, foveolate, 2-celled ascospores places this fungus in the Montagnulaceae and *Didymosphaerella*. Several collections of *Didymosphaerella yuccae* exist, and in these collections the fungus is often accompanied by *Montagnula yuccigena* A. W. Ramaley & M. E. Barr. This could also suggest relationship of the two genera.

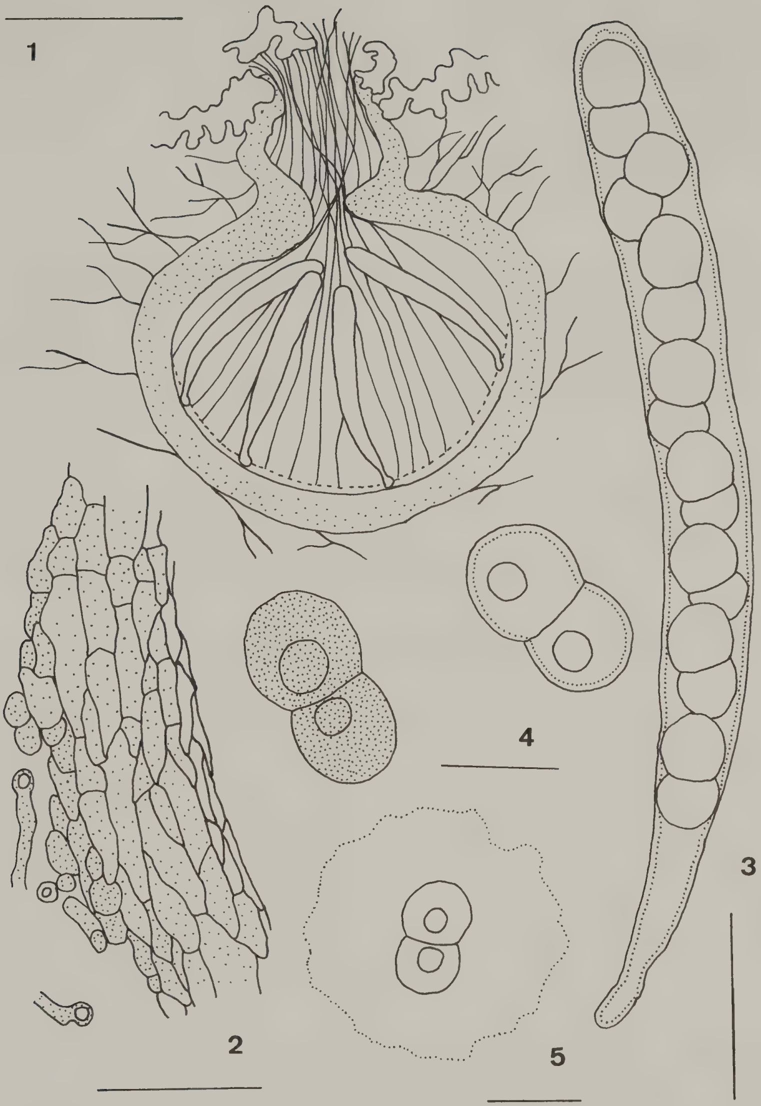

FIG. 1-5. *Didymosphaerella yuccae.* FIG. 1. Diagram of small ascoma showing some of the hyphae surrounding the peridium, and periphyses and pseudoparaphyses extending through the host epidermis. Bar=160 μm. FIG. 2. Detail of peridium. Bar=40 μm. FIG. 3. Ascus with 8 ascospores. Bar=50 μm. FIG. 4. Ascospores, one illustrated in section to show thick wall. Bar=17 μm. FIG. 5. Ascospore surrounded by broad sheath in water mount. Bar=25 μm.

Other species of *Didymosphaerella* can be easily separated from *D. yuccae. Didymosphaerella longipes* (Trabut) Cooke, from leaves of *Agave americana*, has much smaller ascospores {12-18 x 6-7.5 (-10) μm} with foveolae arranged in longitudinal striae. The largest ascospores of *Didymosphaerella opulenta* (DeNot.) Checa & M. E. Barr, from *Opuntia*, attain the length of the the smallest ascospores of *D. yuccae*, but all those of *D. opulenta* are considerably narrower (22-28 x 8-12 μm) and smooth walled.

ACKNOWLEDGEMENTS

My thanks to personnel of Guadalupe Mountains National Park for their permission to collect within the park boundaries and for their encouragement in this project. I also thank Margaret Barr for her long-standing interest in this fungus, for delimiting a family and describing a genus in modern terms in which it now can be placed satisfactorily, and for her review of this manuscript!

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MYCOTAXON

Volume LXXVIII, pp. 439-448 April-June 2001

NOTES ON THREE WHITE AMANITAE OF SECTION PHALLOIDEAE (AMANITACEAE) FROM CHINA*

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Abstract: Three taxa of the genus *Amanita* section *Phalloideae* with white basidiocarps are described and illustrated. They are *A. exitialis*, *A. oberwinklerana* and *A. subjunquillea* var. *alba*. The first species is new to science, while the second is new for China. Known distribution range of the third taxon in China is widely extended. *Amanita exitialis* is lethal, while the other two taxa are supposed to be also very poisonous. The holotype of *A. exitialis* is deposited in the Mycological Herbarium of Guangdong Institute of Microbiology (HMIGD).

Key words: *Amanita exitialis*, new species, lethal mushrooms

Mushrooms of the genus *Amanita* with a white basidiocarp, a non-appendiculate pileal margin, a membranous limbate volva on the stipe base and amyloid spores, belonging in the section *Phalloideae* (Fr.) Quél., seem to be quite common and widely distributed in China. They were usually referred to *A. verna* (Bull.: Fr.) Lamarck or *A. virosa* (Fr.) Bertillon, both originally described from Europe. Critical restudy of specimens deposited in the Herbarium of the Institute of Microbiology of the Chinese Academy of Sciences (HMAS), in the Cryptogamic Herbarium of Kunming Institute of Botany (HKAS) and in the Mycological Herbarium of Guangdong Institute of Microbiology (HMIGD) shows that there are at least three separate taxa of this group occurring in China. The results are reported in the following account. Color codes of the form "1A1" are from Kornerup & Wanscher (1981); Color names with first letters capitalized (e.g., Cream Color) are from Ridgway (1912).

1. *Amanita exitialis* Z. L. Yang & T. H. Li, sp. nov. Figs. 1–4

Etymology: *exitialis,* destructive, on account of its lethal poison.

Pileus 4–7 cm latus, convexus vel applanatus, albus vel albidus, glabrus, margine non striata, non appendiculata. Lamellae liberae, albae vel albidae, confertae, lamellulis attenuatis. Stipes 7–9 × 0.5–1 cm, albus vel albidus,

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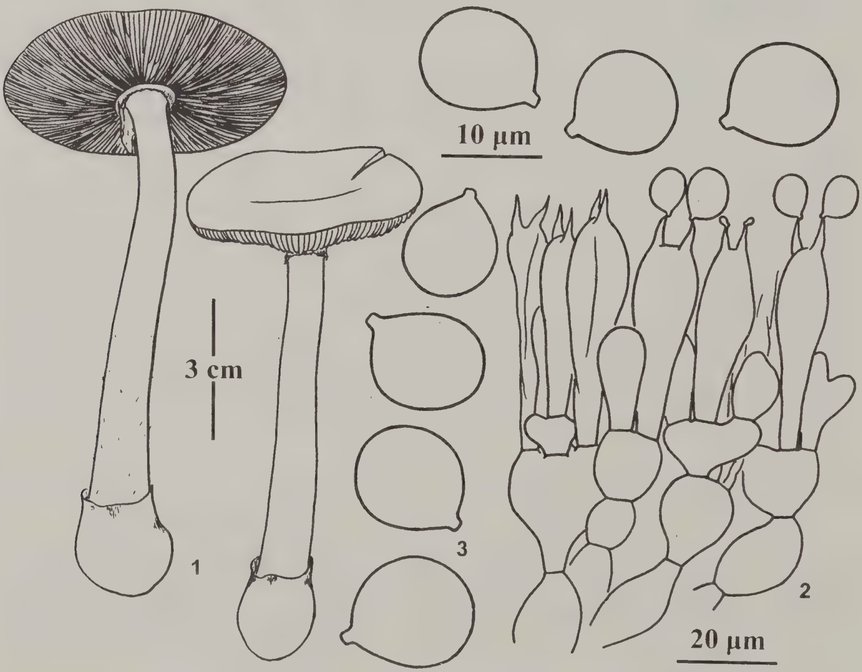
* This project was supported by the Natural Science Foundation of Yunnan Province, China (Grant No. 98C026Q), and by the National Natural Science Foundation of China (Grant No. 39800007).

annulatus; Bulbus volvatus, subglobosus, 1–2 cm latus. Volva breviter limbata, alba, tenuissima, praecipue ex hyphis filamentosis composita. Annulus membranaceus, albus, apicalis vel subapicalis, ex hyphis filamentosis, in partibus subaequalis inter cellulas clavatas, lato-clavatas vel elliposoideas mixtis compositus. Caro alba. Basidia 2-sporigera. Sporae (9.0–)9.5–12.0(–14.5) × (8.5–)9.0–11.5(–13.0) µm, globosae vel subglobosae, amyloideae. Fibulae absentes. Holotypus: T. H. Li et al. s.n. (HMIGD 20241), 23. III. 2000, Guangzhou, Guangdong, China.

Basidiocarp (fig. 1) small to medium-sized. **Pileus** 4–7 cm in diameter, convex to applanate, sometimes slightly depressed at center, glabrous, white [1A1], but cream-colored over disc [2A2, 2A3; Cream Color, Pale Chalcedony Yellow]; margin non-striate, non-appendiculate; trama white. **Lamellae** free, white to whitish [1A1, 1A2], crowded, up to 5 mm in height; lamellulae attenuate, plentiful, in 2-3 ranks. **Stipe** 7–9 × 0.5–1 cm, subcylindric or slightly tapering upward, with apex slightly expanded, white to whitish, glabrous, or sometimes with fibrillose squamules; context white. Basal bulb subglobose, 1–2 cm wide. Volva shortly limbate, thin, membranous, with free limb up to 7 mm in height, both surfaces white. **Annulus** apical to subapical, thin, membranous, white, persistent or torn from stipe during expansion of pileus.



Figs. 1–3: *Amanita exitialis* (HMIGD 20241, holotype).
1. Basidiocarps. 2. Basidia and subhymenium. 3. Basidiospores

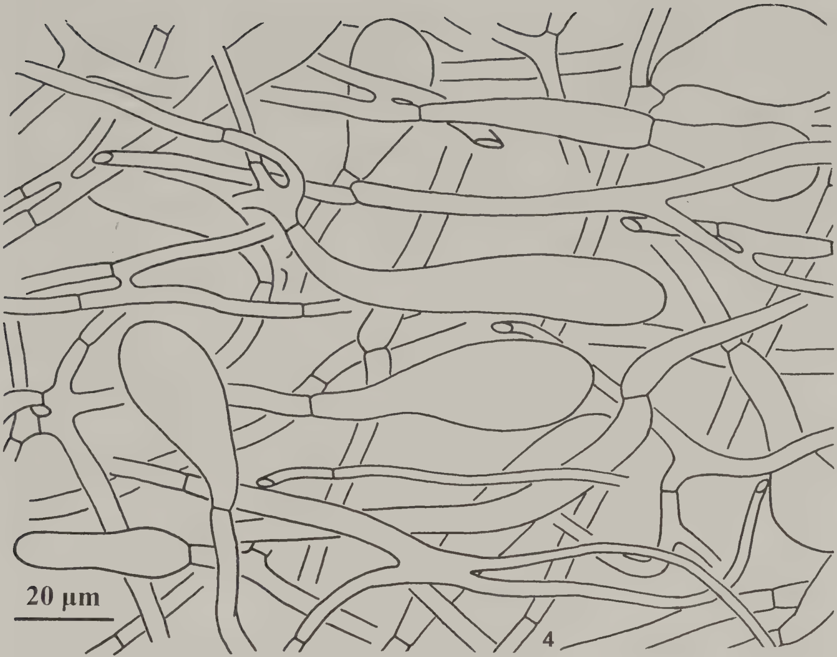


Fig. 4: Radial section of annular trama of *Amanita exitialis* (HMIGD 20241, holotype)

Lamella trama bilateral: mediostratum 30–40 µm wide, made up of fairly abundant to abundant, ellipsoid to fusiform cells (60–90 × 12–20 µm), mixed with fairly abundant to abundant, filamentous hyphae, 2–6 µm wide, branching, interwoven, sometimes anastomosing; lateral stratum made up of fairly abundant to abundant, clavate to subfusiform cells (40–70 × 10–20 µm), mixed with abundant filamentous hyphae, 2–6 µm wide, diverging at an angel of 30°–45° to the central stratum. **Subhymenium** (fig. 2) 30–40 µm thick, with 2–3 layers of subglobose, ovoid to irregularly shaped cells, 10–25 × 8–23 µm. **Basidia** (fig. 2) 27–55 × 10–15 µm, clavate, 2-spored, rarely 1-spored; sterigmata 5–7(–9) µm long; basal septa without clamps. **Basidiospores** (fig. 3) [80/3/1][1] (9.0–) 9.5–12.0 (–14.5) × (8.5–) 9.0–11.5 (–13.0) µm [Q = 1.0–1.15 (–1.17), **Q** = 1.08 ± 0.04], globose to subglobose, rarely broadly ellipsoid, amyloid, colorless, hyaline, thin-walled, smooth; apiculus small. **Lamella edge** consisting of numerous subglobose to sphaeropedunculate cells (14–25 × 13–20 µm) or broadly clavate cells (20–25 × 12–15 µm), single or 2–3 in chain, thin-walled, colorless, hyaline. **Pileipellis** 30–50 µm thick: the upper layer (15–30 µm thick) gelatinized, made up of ± radially arranged, filamentous hyphae, 2–5 µm wide, colorless, hyaline; the lower layer (15–30 µm thick) made up of radially and compactly arranged filamentous hyphae, 3–8 µm wide, not gelatinized; vascular hyphae rare. **Volval remnants** on the stipe base dominantly made up of irregularly and compactly arranged filamentous hyphae 2–7 µm wide, thin-walled to slightly thick-walled (⩽ 0.5 µm thick), colorless, hyaline, interwoven, sometimes anastomosing, clampless; inflated cells rare to scattered, subfusiform and intercalary (60–120 × 15–20 µm), rarely terminal and ovoid (50–100 × 35–80 µm), thin-walled, hyaline; vascular hyphae rare. Outer surface of the volva similar to its interior; inner surface of the volva gelatinized, with filamentous hyphae, 1–5 µm wide. Volval remnants on pileus not seen. **Stipe trama** dominantly consisting of longitudinally arranged, long clavate, terminal cells (200–400 × 20–35 µm), mixed with scattered (in interior) to fairly abundant (on stipe surface) filamentous hyphae, 2–8 µm wide; vascular hyphae rare, 2–10 µm wide. **Annulus** (fig. 4) made up of abundant to very abundant filamentous hyphae, 2–7 µm wide, thin-walled, colorless, hyaline, frequently branching and anastomosing; mixed with abundant clavate to broadly clavate cells (30–70 × 10–25 µm) or ellipsoid cells (35–90 × 12–15 µm), sometimes ovoid cells (25–35 × 17–25 µm), thin-walled, colorless, hyaline, usually single; vascular hyphae rare, 2–5 µm wide.

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[1] 80 spores from 3 basidiocarps of 1 collection measured in 5% KOH solution; Q is used to mean "length/width ratio" of a spore; **Q** means average Q of all spores ± sample standard deviation.

Specimen examined: GUANGDONG PROV: Guangzhou, alt. 50 m, 23.III. 2000, T.-H. Li *et al. s.n.* (HMIGD 20241, holotype!).

Habitat and Distribution: Solitary or gregarious on ground in a broad-leaved forest. Only known from the type locality.

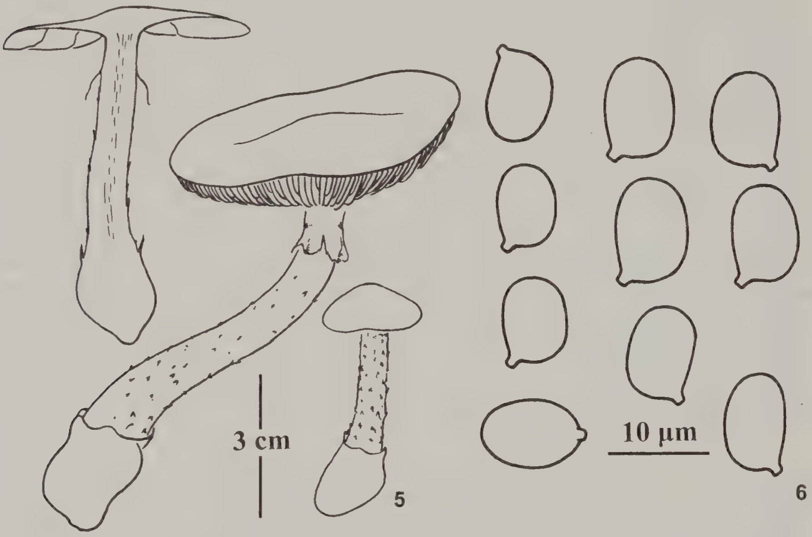
Observations: In middle March of 2000 a disaster happened in Guangzhou, southern China due to eating this mushroom. Nine persons ate the mushroom, only one of them survived. Uncooked remnants of the lethal mushroom and additional material subsequently gathered from the original collecting site were studied anatomically and taxonomically. It turned out to be an undescribed species of the genus *Amanita* subgenus *Lepidella* section *Phalloideae*, and is described here as *A. exitialis. Amanita exitialis* is characterized by its white, small to medium-sized fruitbody with a somewhat friable, apical to subapical annulus and a firm limbate volva, bispored basidia, and amyloid, globose to subglobose spores. It is similar to *A. bisporigera* Atkinson, originally described from the United States. *Amanita exitialis* differs, however, from *A. bisporigera* in its apical to subapical annulus, larger spores (Jenkins, 1986; Tulloss *et al.*, 1995), and different structure of the volva. The volva of *A. bisporigera* from the USA [Virginia: near Mt. Lake, Giles Co., 23. VII–25. VIII. 1946, R. Singer *s.n.* (FH); New York: Ithaca, C. H. Kauffman, *s.n.* (Herb. Atkinson, FH)] includes more abundant inflated cells than that of *A. exitialis*. The spores of *A. bisporigera* from the two North American collections are [50/2/2] (7.0–)8.0–9.5(–10.0) × (6.5–)7.0–8.5(–9.0) µm [Q = 1.04–1.16(–1.25), **Q** = 1.12 ± 0.07]. *Amanita phalloides* var. *striatula* Peck (1902), a poorly known taxon described from the United States, also has white fruitbodies and bispored basidia, but it differs from *A. exitialis* at least by its smaller spores (Tulloss unpublished data). The volval structure of *A. phalloides* var. *striatula* is still unknown.

Amanita oberwinklerana Z. L. Yang & Y. Doi and *A. subjunquillea* var. *alba* Z. L. Yang look like *A. exitialis*, but the former two have 4-spored basidia. Furthermore, *A. oberwinklerana* has a lower annulus, a weak volva with abundant inflated cells, and smaller, broadly ellipsoid to ellipsoid spores, while *A. subjunquillea* var. *alba* has lower annulus and significantly smaller spores (Yang, 1997; Yang & Doi, 1999; also see below).

2. *Amanita oberwinklerana* Z. L. Yang & Y. Doi in Bull. Natn. Sci. Mus., Tokyo, Ser. B. **25:** 120, figs. 20–25 (1999). Figs. 5–6

Basidiocarp (fig. 5) small to medium-sized. **Pileus** 3–6(–8) cm in diameter, first nearly hemispherical, then becoming convex to applanate, regularly formed, later often concave, white, center white or sometimes cream-colored, glabrous or sometimes with white, membranous volval remnants often in 1–3 large pieces on pileus, randomly arranged; margin smooth, non-appendiculate; trama white. **Lamellae** free, first white, then white with cream-colored tinge, becoming cream-colored to pale yellowish when mature; lamellulae attenuate, plentiful, in 2–3 ranks. **Stipe** 5–7(–9) × 0.5–1(–1.5) cm, attenuate upward, with apex slightly expanded, white, finely fibrillose or with reflexed squamules; context white. Basal bulb subglobose to napiform, 1–2 cm wide. Volva short limbate to limbate, thin, membranous, with free limb up to 1 cm in height; inner surface white; outer surface white, sometimes with cream-colored tinge. **Annulus** present, superior, pendant from ca. 1–1.5 cm below apex of stipe, membranous, white, fine radially striate above.

Basidia 30–55 × 9–12(–15) µm, clavate, 4-spored, sometimes 1-or 2-spored; basal septa without clamps. **Basidiospores** (fig. 6) [130/7/3] (7.5–)8.0–10.0(–11.0) × (5.5–)6.0–7.0(–7.5) µm [Q = (1.14–)1.26–1.54(–1.64), **Q** = 1.38 ± 0.09] ellipsoid, sometimes broadly ellipsoid, rarely elongate, amyloid, colorless, hyaline, thin-walled, smooth; apiculus small. **Volval remnants** on pileus made up of irregularly arranged elements: filamentous hyphae abundant to very abundant, becoming dominant near the surface of pileus, 2–10 µm wide, branching, interwoven, colorless, hyaline, thin- to slightly thick-walled (ca. 0.5 µm thick, sometimes up to 1 µm thick); inflated cells fairly abundant to abundant, subglobose to ovoid (30–50 × 25–40 µm), sometimes ellipsoid (45–60 × 25–35 µm), terminal, usually single, sometimes 2–3 in chain, colorless, hyaline, thin- to slightly thick-walled (ca. 0.5 µm thick, sometimes up to 1 µm thick); vascular hyphae rare. Volval remnants on stipe base made up of ± longitudinally to irregularly arranged elements: inflated cells abundant to fairly abundant, but becoming rare towards the inner surface, ovoid to subglobose to short ellipsoid (25–50 × 20–40 µm), terminal, usually single, sometimes 2–3 in chain, colorless, hyaline, thin- to slightly thick-walled (ca. 0.5 µm thick, sometimes up to 1 µm thick), mixed with filamentous hyphae 2–5(–12) µm wide, abundant to very abundant, towards inner surface dominant, thin- to slightly thick-walled. Outer surface of the volva similar to the interior; inner surface strongly gelatinized, with filamentous hyphae 1–5 µm wide. **Annulus** consisting of subradially arranged, very abundant to dominant, filamentous hyphae, 2–7 µm wide, thin- to slightly thick-walled, branching and anastomosing, mixed with scattered to locally fairly abundant (at upper surface and at edge of annulus abundant), broadly clavate, subglobose to ovoid to sphaeropedunculate, sometimes ellipsoid inflated cells, 15–65 × 12–25 µm, colorless, hyaline, thin- to slightly thick-walled (ca. 0.5 µm thick), terminal, usually single, sometime 2–3 in chain; vascular hyphae rare.



Figs. 5–6: *Amanita oberwinklerana* (HKAS 32526).
5. Basidiocarps. 6. Basidiospores

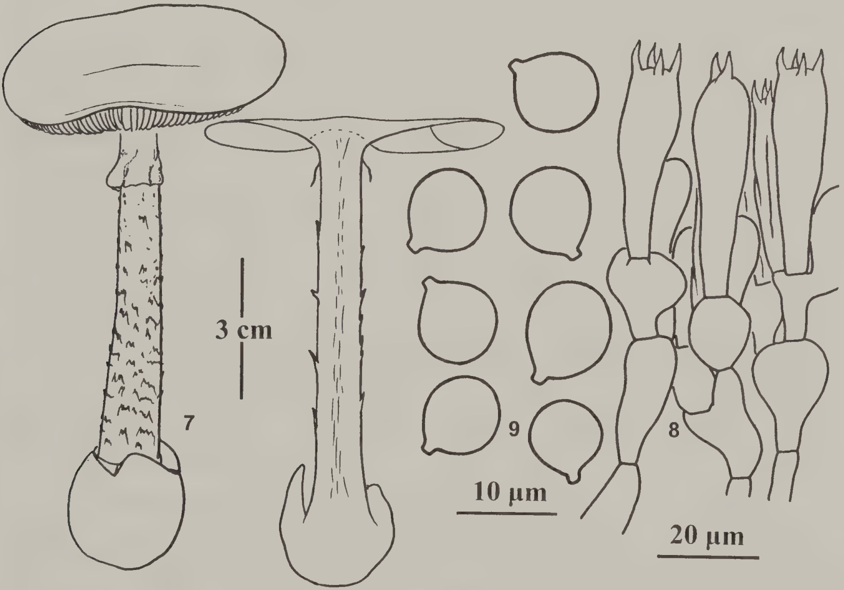
Specimens examined: SICHUAN PROV.: Muli, Forest Station No. 913, alt. 3350, 27.VIII.1983, K.-K. Chen 850 (HKAS 13773). GUIZHOU PROV.: Lipo, Maolan, 2.VIII.1988, J.-Z. Ying *et al.*, G600 (HMAS 57978, as *A. virosa* in Ying & Zang, 1994). GUANGDONG PROV.: Guangzhou, Baiyunshan, alt. 380 m, 2.IX.1998, Z.-L. Yang 2493 (HKAS 32526).

Habitat and Distribution: Solitary or gregarious on ground in broad-leaved or coniferous forest. It was originally described from Japan and reported here as new for China.

Observations: For a more detailed description of *A. oberwinklerana* see Yang & Doi (1999). *Amanita oberwinklerana* is supposed here to be poisonous considering its morphological and anatomical features. The chemical constituents of this taxon are yet unknown.

3. *Amanita subjunquillea* var. *alba* Z. L. Yang in Biblioth. Mycol. **170:** 174, Abb. 143–144 (1997) Figs. 7–9

Basidiocarp (fig. 7) small to medium-sized. **Pileus** (2–)3–10 cm in diameter, first hemispherical, then convex to plano-convex to applanate, white to whitish, sometimes pale cream-colored to pale yellowish at disc, subviscid, glabrous and usually without volval remnants; margin smooth or sometimes finely striate, non-appendiculate; context white to whitish. **Lamellae** free, crowded; lamellulae 0–2 between a pair of lamellae, attenuate. **Stipe** 5–14.5 × 0.3–2 cm, subcylindrical or slightly tapering upward, white to whitish, smooth or with white fibrils or reflexed squamules. Basal bulb subglobose, 0.7–2(–3) cm wide. Volva limbate, membranous, sometimes leathery, with free limb up to 1.5 cm in height and 4 mm in thickness, both surfaces white to whitish. **Annulus** present, 0.5–2(–3) cm below apex of stipe, white, membranous or friable.



Figs. 7–9: *Amanita subjunquillea* var. *alba* (HKAS 32665).
7. Basidiocarps. 8. Basidia and subhymenium. 9. Basidiospores

Basidia (fig. 8) 30–48 × 8.5–12(–15) µm, clavate, 4-spored, occasionally 1- or 2-spored; sterigmata 3–5 µm long; basal septa without clamps. **Basidiospores** (fig. 9) [532/28/20] (6.0–)6.5–9.0(–10.5) × (5.5–)6.0–8.5(–10.0) µm [Q = 1.0–1.15(–1.23), **Q** = 1.08 ± 0.05], globose to subglobose, rarely broadly ellipsoid, amyloid, colorless, hyaline, thin-walled, smooth; apiculus small. **Volval remnants** on the stipe base made up of ± longitudinally to irregularly arranged elements: trama dominantly made up of filamentous hyphae 3–15(–20) µm wide, colorless, hyaline, thin- to slightly thick-walled (up to 1 µm thick), branching, sometimes anastomosing; inflated cells rare to scattered to locally fairly abundant, ovoid to subglobose (40–110 × 30–80 µm) to ellipsoid (60–120 × 35–60 µm) to clavate (90–120 × 10–45 µm), terminal, usually single, sometimes 2–3 in chain, colorless, hyaline, thin- to slightly thick-walled (up to 1 µm thick); vascular hyphae rare. Inner surface of the volva made up of gelatinized, filamentous hyphae 1.5–5(–8) µm wide; outer surface of the volva made up of filamentous hyphae (3–)5–10(–20) µm wide, colorless, hyaline, thin- to slightly thick-walled (up to 1 µm thick). **Annulus** dominantly consisting of subradially arranged, filamentous hyphae, 2–7(–10) µm wide, thin- to slightly thick-walled, branching, sometimes anastomosing, mixed with scattered to locally fairly abundant, clavate to broadly clavate to ellipsoid, occasionally subglobose to ovoid, inflated cells, 18–75 × 10–45 µm, colorless, hyaline, thin-walled, terminal, usually single, occasionally 2–3 in chain; vascular hyphae rare.

Specimens examined: GANSU PROV.: Wen County, Tielou, IX.1992, M.-L. Tian 7003 (HMAS 61678, as *A. verna* in Mao, 1997); same time and same location, M.-L. Tian 6506 (HMAS 61692); Wudu County, IX.1992, X.-L. Mao 7039 (HMAS 61629, as *A. verna* in Mao, 1997). SICHUAN PROV.: detailed location unknown, in 1894, Farges *s.n.* (Herb. Patouillard, FH 4285, identified as *A. vaginata* by N. Patouillard); Xichang County, Luojishan, alt. 2100 m, 18. VII.1983, M.-S. Yuan 31 (HKAS 11831); Emei County, Emeishan, 29.VIII. 1971, S.-X. Wu, Y.-C. Zong & X.-L. Mao 284 (HMAS 35540, as *A. virosa* in Ying & Zang, 1994); Chongqing County, 1.VII.1971, Y.-C. Zong, X.-L. Mao & S.-X. Wu 218 (HMAS 35766, as *A. verna* in Ying & Zang, 1994). XIZANG (TIBET) AUTONOMOUS PREFECTURE: Chayü County, 1.IX.1976, M. Zang 664 (HKAS 5664, as *Lepiota cristata* in Wang & Zang, 1983). YUNNAN PROV.: Menghai County, Mangao, 14.VIII.1991, Z.-L. Yang 1530 (HKAS 24169); Yiliang County, Mugan, 20.IX.1998, Z.-L. Yang 2517 (HKAS 32665). GUIZHOU PROV.: Daozhen County, Dashahe, 20.VII.1988, J.-Z. Ying *et al.* 471 (HMAS 58289, as *A. verna* in Ying & Zang, 1994). HENAN PROV.: Lushi County, Siziping, 18.VIII.1968, H.-Z. Li, X.-L. Mao & J.-Z. Ying 14 (HMAS 35743, as *A. verna* in Mao, 1997). HEBEI PROV.: Shennongjia, 29.VIII.1984, X.-Q. Zhang & S.-X. Sun 402 (HMAS 53766, as *A. verna* in Mao *et al.*, 1989). SHANXI PROV.: Hanzhong, IX.1991, X.-L. Mao 6394 (HMAS 61495, as *A. verna* in Mao, 1997); Hanzhong, 19.IX.1991, X.-L. Mao 3811 (HMAS 61594, as *A. verna* by Mao, 1997); Hanzhong, 20.IX.1991, X.-L. Mao 6367 (HMAS 61671, as *A. verna* in Mao, 1997); Hanzhong, IX.1991, X.-L. Mao 4014 (HMAS 61731, as *A. virosa* in Mao, 1997). BEIJING: Miyun County, 4. VIII. 1978, Y.-C. Zong *s.n.* (HMAS 40501); same location, in 1970, X.-L. Mao & Y.-

C. Zong *s.n.* (HMAS 35536). JILIN PROV.: Antu County, 4.IX.1960, Y-C. Yang *et al.* 1039 (HMAS 29134, as *A. verna* in Teng, 1963 & 1996).

Habitat and Distribution: Solitary or gregarious on ground in broad-leaved, mixed, or coniferous forest dominated by Fagaceae and/or Pinaceae. This taxon was previously known only from southwestern China and Japan (Yang, 1997; Yang & Doi, 1999). The collections listed above show that it is widely distributed in China.

Observations: For a more detailed description of *A. subjunquillea* var. *alba* see Yang (1997). Patouillard (1895) first recorded *A. vaginata* (Bull.: Fr.) Lamarck from China, without any citation of vouchers. In Patouillard's herbarium housed at Farlow Herbarium (FH), the first author found one collection of *Amanita*, as cited above. This collection, identified as *A. vaginata* by N. Patouillard, may be the only (?) such voucher. It is a representative of *A. subjunquillea* var. *alba* due to its white to whitish cap with smooth margin, the membranous volva on the stipe base, and the distinctly amyloid, globose to subglobose, small spores.

Amanita subjunquillea var. *alba* seems to be widely distributed in China, but usually it has been wrongly treated as *A. virosa* or *A. verna*. S. C. Teng first reported *A. verna* from Nanjing (Nanking), China (Teng, 1937). The only voucher specimen cited by Teng (1937), i.e. Teng 2749, is not available for the authors to study. But Teng probably regarded the spores of at least some of the collections studied by him as immature when dried, because he describes the spores under *A. verna* as "hyaline, smooth, subglobose, 9–12 × 8–10 µm, immature ones 7–8 × 6 µm" (Teng, 1937: 425; Teng, 1996: 449). The so-called "immature" specimens of *A. verna* may actually be members of *A. subjunquillea* var. *alba*; the former differs from the latter in, among other features, its ellipsoid spores (see Yang, 1997: 181; Yang & Doi, 1999: 122). For comparison of *A. virosa* and *A. subjunquillea* var. *alba* see Yang (1997: 177) and Yang & Doi (1999: 127).

The fresh basidiocarps of *A. subjunquillea* var. *alba* give yellow reactions to 5% KOH solution [tested on the collection Yang 2517 (HKAS 32665)]. Since *A. subjunquillea* Imai is lethal (Kawase *et al.*, 1992), it is supposed that *A. subjunquillea* var. *alba*, phylogenetically close to *A. phalloides* (Fr.) Link (Weiß *et al.*, 1998), is also poisonous.

Acknowledgements

The first author is very grateful to the following persons for their kind help and support: Dr. R. E. Tulloss, New Jersey, sent him valuable papers and unpublished data on *Amanita*, and critically reviewed the manuscript; Prof. Dr. D. H. Pfister, Boston, and Prof. Dr. L. Guo, Beijing, allowed him to study collections of *Amanita* housed in their herbaria; Dr. C. Bas, Leiden, gave him comments on the author-citation of the name *Amanita virosa*.

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MYCOTAXON

Volume LXXVIII, pp. 449-490 April-June 2001

FOLIAR AND STEM FUNGAL PATHOGENS OF PROTEACEAE IN HAWAII

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ABSTRACT

Several diseases are newly reported on *Proteaceae* from Hawaii, where these plants are cultivated as exotics. New records of leaf spot pathogens include *Coleroa senniana, Botryosphaeria proteae*, *Fusicoccum* sp., *Leptosphaeria protearum*, *Phyllosticta telopea* and *Pestalotiopsis* spp. New species such as *Chaetochalara proteae*, *Physalospora hawaiiensis*, *Heteroconium neriifoliae*, *Mycosphaerella holualoana, M. konae, M. waimeana* and *Stictis leucospermi* are also described from leaf spots. Several common stem pathogens are recorded, namely *Colletotrichum gloeosporioides, Botryosphaeria dothidea, Drechslera dermatoidea, Elsinoë banksiae* and *E. leucospermi.* In addition to providing descriptions and cultural data for these pathogens, this paper also provides baseline data of *Proteaceae* pathogens occurring in Hawaii.

KEY WORDS: Fungal pathogen, phytosanitary, systematics.

INTRODUCTION

Fungal pathogens of *Proteaceae* (proteas) are currently being assessed in countries where these plants are native, such as South Africa (Swart et al. 1998; Crous and Palm 1999; Taylor and Crous 2000) and Australia (Crous et al. 2000), and where they have been cultivated as exotics, such as the U.S.A. [California (Taylor et al. 2001) and Hawaii (present paper)] and Europe (S. Denman and J.E. Taylor, unpubl. data). The recent interest is due partly to the increased demand for proteas as cut flowers, especially for export markets, and the phytosanitary and quarantine concerns resulting from fungal pathogens during production and export. Also, with the increasing global movement of propagation material, it is essential to be aware of the plant pathogens in different countries, in order to prevent the introduction of these into new areas or countries. This is important, for example, when considering the re-introduction into South Africa of *Proteaceae* cultivated outside South Africa. It is necessary to assess the risk to native and cultivated flora in South Africa from fungi elsewhere, which have adapted to these hosts. Currently, little is known about the distribution, host ranges and pathogenicity of many of the fungi on *Proteaceae.*

This study was initiated to determine what fungal pathogens are present on proteas in Hawaii, as part of a larger study aimed at comparing fungal pathogens of proteas in South Africa and the U.S.A. In the U.S.A. proteas are cultivated in California and Hawaii and a report of fungi on proteas in California is currently being published (Taylor et al. 2001). In Hawaii, protea cultivation has been carried out for approximately 25 years and is a US $1 million industry. Approximately 80% of the original germplasm came from South Africa, with some originating from Australia (S. Ferreira, pers. comm.). Therefore, it would not be surprising if some fungi present on proteas in Hawaii are the same as those present in these countries. Some fungal diseases of Hawaiian proteas have been reported (The Protea Disease Management Group, 1991, 1993; Protea Disease Letter., unpubl. reports). This work was intended to further our knowledge of the mycobiota of the Hawaiian proteas, in order to determine which diseases are of greatest importance for cultivation and quarantine purposes.

METHODS AND MATERIALS

Symptomatic leaf and stem samples of cultivated *Proteaceae* (*Banksia* L. f., *Grevillea* R. Br. ex Knight, *Leucospermum* R. Br., *Leucadendron* R. Br., *Protea* L. and *Telopea* R. Br.) were collected and surveyed for the presence of sporulating fruiting structures. Material was treated as outlined by Taylor and Crous (2000). Single ascospore or conidium isolates were established on 2% malt extract agar (MEA; Biolab, Midrand, South Africa), supplemented with 0.1g/l streptomycin sulphate. These were then transferred to divided plates containing MEA and carnation leaf agar (CLA, Fisher et al. 1982) to encourage sporulation. Incubation was at 25ºC under continuous nuv light. Colony growth was measured, characteristics noted, and the colour rated (Rayner 1970). For microscopic examination the fungi were mounted in water or lactophenol and measurements made at

×1000 magnification. The 95% confidence intervals were determined from 25–50 observations and the minimum and maximum values given in parentheses. Herbarium specimens are lodged mostly at PREM, with some specimens at HKU(M) and IMI. Reference cultures are maintained in the culture collection of the Department of Plant Pathology, University of Stellenbosch (STE-U).

TAXONOMY

Chaetochalara proteae Joa.E.Taylor, Crous & M.E.Palm, sp. nov.
Figs. 1–4

Maculae foliorum morboscentes, pallide flavide-brunneae, circulares. Coloniae amphigenae, atrobrunneae vel atrae. Fertiles hyphae exorientes super stomata vel e stomatibus, ferentes phialides et setas. Setae simplices, usque ad octoseptatas, atrobrunneae vel rufobrunneae, circa 7.5 µm base et 2–3 µm apice, pariete laevi, usque ad 250 µm longae. Phialides in hyphis fertilibus, vel in conidiophoribus brevibus, subcylindricae, pallidae vel medio brunneae, verruculosae, interdum proliferantes percurrentes, 7–10 µm base, 6–8 µm apice, 70–90 µm longae. Conidia in catenis, cylindrica, apice rotundato, base truncata, uniseptata, septo non constricto, hyalina, pariete laevi (0.5–1 µm lato), (9–)10.5–12(–14) × (5–)6.5–7 µm.

ETYMOLOGY: Referring to the host *Protea*.

Leaf spots necrotic, sunken with raised borders, pale yellowish-brown, circular. Colonies amphigenous, diffuse, sparse, dark brown to black. Fertile hyphae superficial, branched, arising above or from stomata, hyaline or brown, smooth-walled bearing phialides and setae. Setae simple, erect, up to 8-septate, uniformly dark-brown to reddish-brown, slightly bulbous at the base (approx. 7.5 µm), tapering gradually towards the apex (approx. 2–3 µm), smooth-walled, up to 250 µm long (Fig. 1). Conidiogenous cells phialidic, mainly borne directly on the fertile hyphae, or singly on short conidiophores, subcylindrical, pale to medium brown, verruculose, enteroblastic regeneration of the conidiogenous cell can occur at the base, 7–10 µm wide at the base, narrowing slightly to 6–8 µm at the apex, and 70–90 µm long (Figs. 1–3). Conidia in chains, cylindrical, rounded at the apex and truncate at the base with an inconspicuous frill, 1-septate, hyaline, wall smooth and relatively thick, 0.5–1 µm wide, not constricted at the septum, (9–)10.5–12(–14) × (5–)6.5–7 µm (Fig. 4).

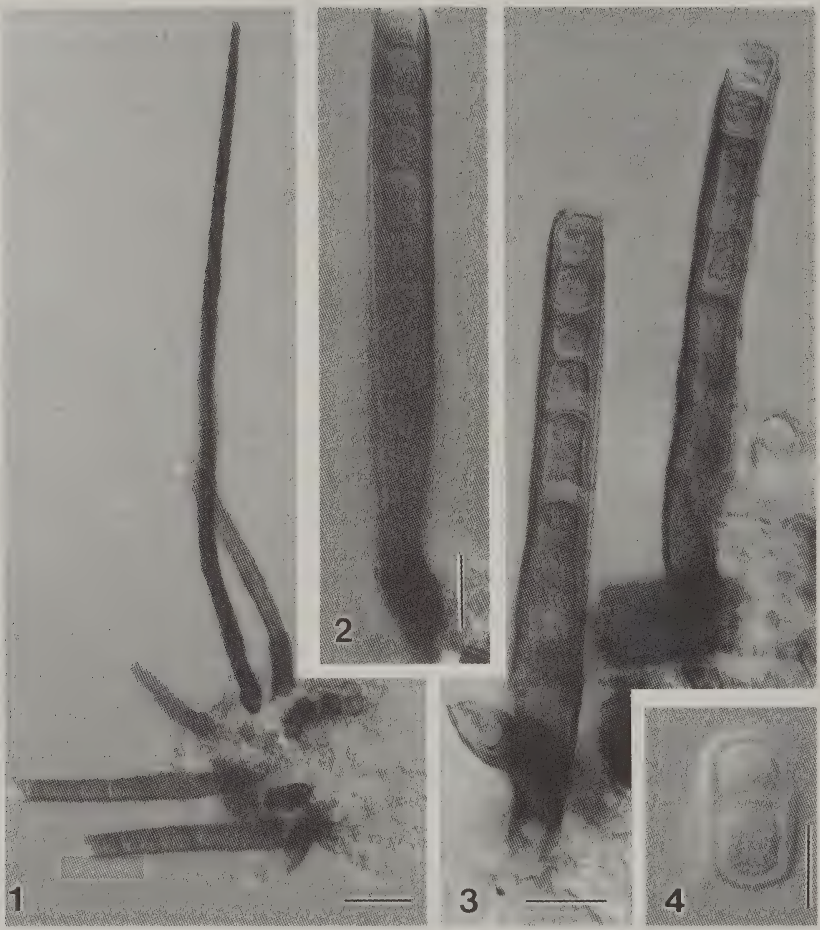
HOLOTYPE: U.S.A.: Hawaii, Kona district, Waimea, leaf spot on *Protea* 'Pink Ice', 17th Nov. 1998, P.W. Crous & M.E. Palm (JT568, PREM 56948).

TELEOMORPH: None known.

HOST RANGE: *Protea* 'Pink Ice'.

GEOGRAPHIC DISTRIBUTION: U.S.A. (Hawaii).

NOTES: *Chaetochalara* B. Sutton & Piroz. is similar to *Chalara*



Figs. 1–4. *Chaetochalara proteae* (holotype). Fig. 1. Setae and conidogenous cells. Figs. 2 and 3. Conidiogenous cells. Fig. 4. Conidium. Scale bars: 1 = 20 µm; 2 and 3 = 10 µm; 4 = 5 µm.

(Corda) Rabenh., differing only in the production of setae (Sutton and Pirozynski 1965; Nag Raj and Kendrick 1975), and some authors consider the two to be congeneric (Kendrick 1980; Kirk and Spooner 1983). For the purposes of the present study, the collection is considered as a species of *Chaetochalara,* as results of current molecular studies are indicating that *Chalara* is polyphyletic (Coetsee et al. 2000; Paulin and Harrington 2000). *Chaetochalara proteae* differs from all previously described species of *Chaetochalara* (Nag Raj and Kendrick 1975), but most closely resembles *C. aspera* Piroz. & Hodges in that the conidiogenous cells possess asperate or roughened walls. *Chaetochalara aspera* has also been recorded on a member of the *Proteaceae*, namely *Knightia excelsa* (Salisb.) R.Br. in New Zealand, but differs from *C. proteae* in that it produces generally longer, narrower, thin-walled conidia (10–27 × 2.5–4 µm) and has long conidiophores (48–140 µm). Other species of *Chaetochalara* with non-asperate conidiogenous cells, have thick-walled conidia with similar dimensions to *C. proteae,* including *C. cladii* B. Sutton & Piroz. (10–18 × 4–5 µm), but which has shorter conidiogenous cells (30–45 µm) (Nag Raj and Kendrick 1975), and *C. ramosa* Nag Raj & W.B. Kendr. (9–14 × 3–4.5 µm), which also has shorter conidiogenous cells (25–38 µm) that arise as branches from the conidiophores (Nag Raj and Kendrick 1975).

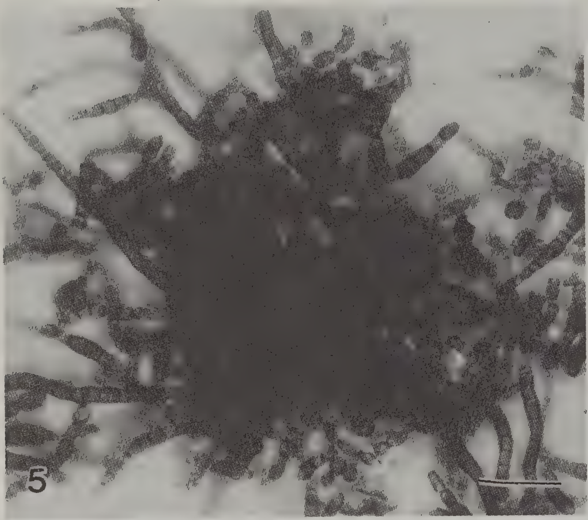
Heteroconium neriifoliae Joa.E.Taylor, Crous & M.E.Palm, sp. nov. Figs. 5–11

Maculae foliorum morboscentes, pallide brunneae, coloniae, atrobrunneae vel atrae. Mycelium superficiale, pallide brunneum vel medium-brunneum, laeve vel verrucosum, 2–5 µm latum. Conidiophora rami laterales hyphae superficialis, cylindrica, rufo-brunnea, multiseptata, pori septales manifesti, verrucosa fissuris longitudinalibus, 8–64 × 4–6 µm. Cellulae conidiogenae holoblasticae, determinatae vel percurrentes, 4–8 × 4–6.5 µm. Conidia cylindrica, praecipue contracta vel ad unum extremum vel ad ambo extrema, blastocatenata, arida, simplicia, verrucosa fissuris longitudinalibus, vel obtusa ad apicem et truncata ad fundum vel truncata ad ambo extrema, usque ad 14 septa leviter constricta, (6–)18–25(–45) × (3.5–)4–4.5(–6) µm.

ETYMOLOGY: In reference to the host *Protea neriifolia* R. Br.

Leaf spots necrotic, pale brown covering almost the whole leaf, colonies diffuse, abundant, dark brown to black. Mycelium superficial, pale to mid brown, smooth-walled to verrucose, branched, reticulate, forming a network over the leaf surface, 2–5 µm wide (Fig. 5). Conidiophores macronematous, mononematous, unbranched, arising as lateral branches on the superficial hyphae, erect, straight, cylindrical, red-brown, multiseptate with septal pores faintly visible, verrucose with longitudinal cracks or creases, 8–64 × 4–6 µm (Figs. 6 and 11). Conidiogenous cells holoblastic, determinate or percurrent, terminal on the conidiophore, 4–8 × 4–6.5 µm (Figs. 6 and 11). Conidia subcylindrical, tapering to one or both ends, blastocatenate, dry, simple, verrucose with longitudinal striations or creases, either obtuse at the apex and truncate at the base or truncate at both ends, with up to 14 septa, (6–)18–25(–45) × (3.5–)4–4.5(–6) µm, becoming slightly constricted at the septa (Figs. 7–10).

CULTURAL CHARACTERISTICS: Colonies irregular with undulate margins, dark greenish brown to black (8'''m), same in reverse.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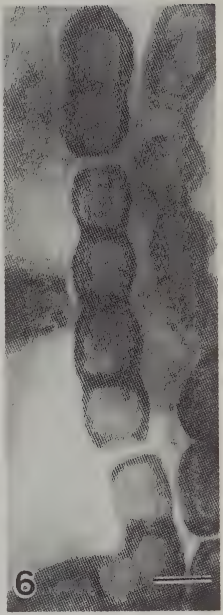
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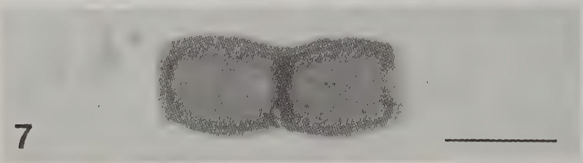
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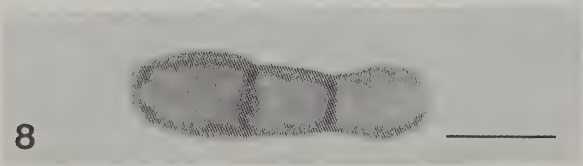
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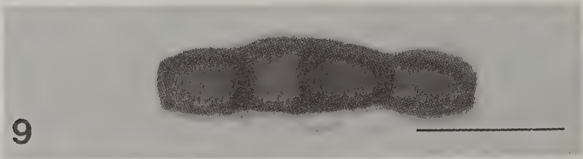
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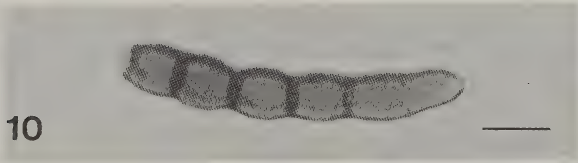
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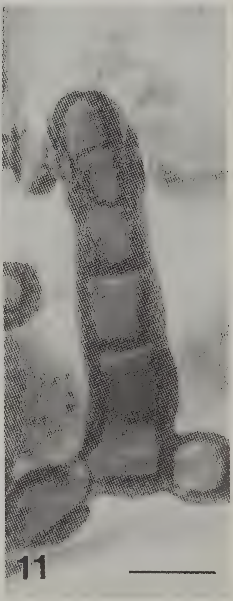
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Moderately dense, aerial mycelium. Colonies reaching 17 mm diam. after 14 d, no anamorph produced.

HOLOTYPE: U.S.A.: Hawaii, Kona district, Waimea, leaf spot of *Protea neriifolia*, 17th Nov. 1998, P.W. Crous & M.E. Palm (JT587, PREM 56958, ex-type cultures STE-U 2182-2184).

ADDITIONAL SPECIMENS EXAMINED: U.S.A.: Hawaii, Kona district, Waimea, leaf spot of *Protea neriifolia*, 17th Nov. 1998, P.W. Crous & M.E. Palm (JT542, PREM 56934); *ibid.*, (JT592, PREM 56962); *ibid.*, *Protea* 'Pink Ice', (JT627, PREM 56985); *ibid.*, *Protea neriifolia*, (JT632, PREM 56987).

TELEOMORPH: Unknown.

HOST RANGE: *Protea neriifolia*, *Protea* 'Pink Ice'.

GEOGRAPHIC DISTRIBUTION: U.S.A. (Hawaii).

NOTES: Ten species of *Heteroconium* Petr. have been described, which occur mainly in warmer areas (Castañeda Ruiz et al. 1999). The characteristics of the genus, and details of genera which are similar to *Heteroconium* are outlined by Castañeda Ruiz et al. (1999) and Morgan Jones (1976). Castañeda Ruiz et al. (1999) describe the conidiogenous cells of *Heteroconium* as being determinate. However, the type *H. citharexyli* Petr. is described as having conidiogenous cells that are determinate or proliferate percurrently (Ellis 1971; Morgan-Jones 1976), and this feature is exhibited by *H. neriifoliae*.

Of all the species previously described in *Heteroconium*, *H. neriifoliae* most closely resembles *H. citharexyli* in conidium shape, septation and dimensions. However, the conidia and conidiogenous cells of that latter species are described as smooth, as are those of all other previously described species of *Heteroconium*, whereas those of *H. neriifoliae* are distinctly ornamented.

Massarina rubi (Fuckel) Sacc., Syll. Fung. 2: 155. 1883.

Figs. 12–18

Leaf spots necrotic, grey-brown covering the whole leaf or situated at the leaf tips, ascomata visible as blackened dots. Ascomata mainly epiphyllous, immersed, subepidermal, substomatal, visible as a slightly raised, darkened area with a central, black, rounded or slot-like ostiole, which becomes erumpent through the stomata, mainly gregarious, or can be single and separate, 100–160 µm wide; in section globose with a round or wide slot-like aperiphysate, papillate ostiole, reduced clypeus consisting of brown

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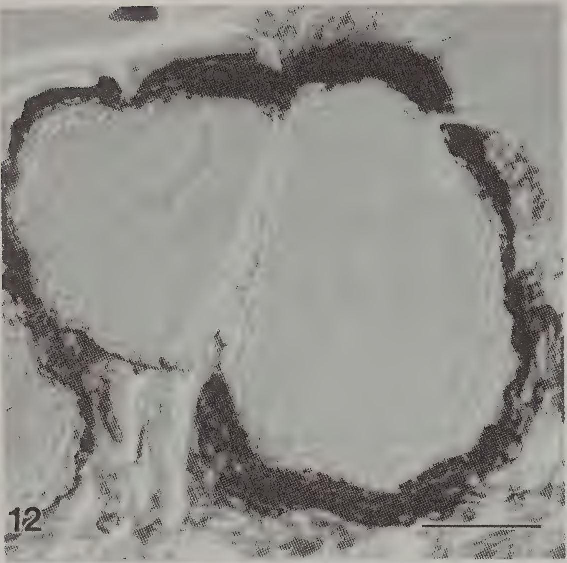
Figs. 5–11. *Heteroconium neriifoliae* (holotype). Fig. 5. Superficial mycelium and condiophores. Figs. 6 and 11. Conidiophores and conidiogenous cells. Figs. 7–10. Conidia. Scale bars: 5 = 20 µm; 6–11 = 5 µm.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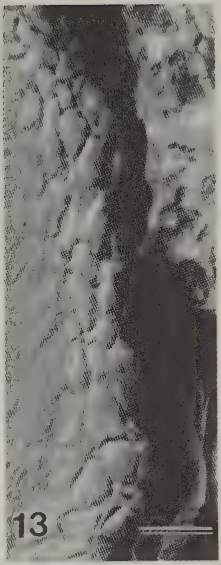
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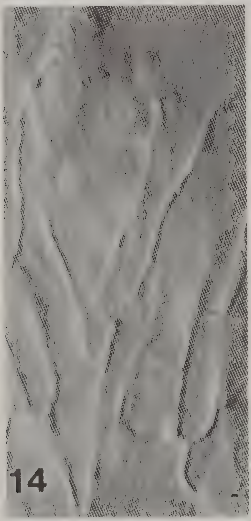
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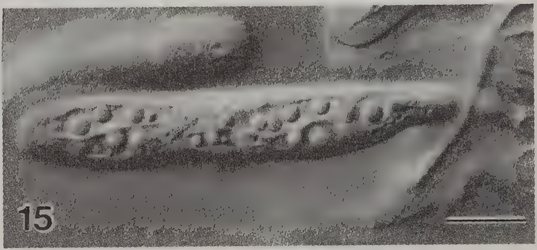
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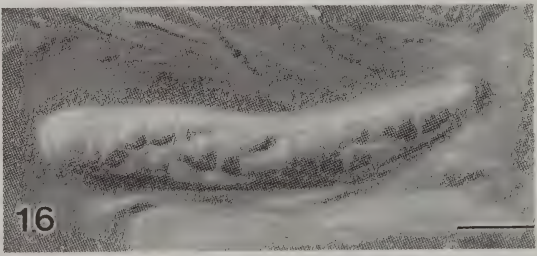
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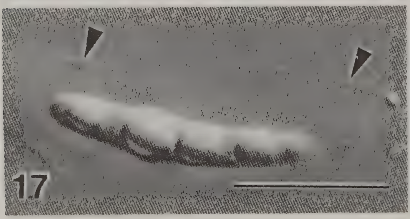
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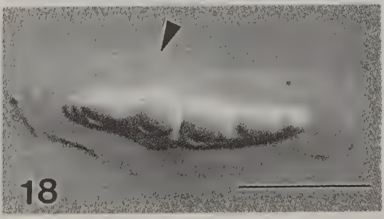
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fungal hyphae within the host cells surrounding the ostiole, asci attached to the base of the peridium, approximately 160–175 µm high × 115–150 µm diam. (Fig. 12). Peridium of equal width at the base and sides, 10–32 µm diam., and gradually widening at the ostiole, comprising two strata, an outer stratum of thick-walled, large lumened, brown, slightly compressed textura angularis, becoming melanised, with occluded lumens surrounding the ostiole; inner stratum comprising thin-walled, hyaline textura angularis (Fig. 13). Pseudoparaphyses cellular, hyaline, anastomising above and sometimes between asci, embedded in a gelatinous matrix, 1–2 µm diam. (Fig. 14). Asci cylindrical to cylindro-clavate, bitunicate, short pedicellate, rounded apex with an indistinct occular chamber, 8-spored, 54–70 × 8–10 µm (Figs. 15 and 16). Ascospores fusiform, bicellular with 2–3 guttules in each cell, constricted at the septum, upper cell bulging above septum, hyaline, smooth, obtuse apices (15–)17–18.5(–22) × (3–)4–4.5(–5.5) µm, surrounded by a uniform mucilaginous sheath, 2–5 µm wide (Figs. 17 and 18).

CULTURAL CHARACTERISTICS: Colonies circular with entire margins, dark brown to black (7’’’’k) in the centre with a pale brown periphery (4’’’i), same in reverse. Moderately dense, aerial mycelium. Colonies reaching 7 mm diam. after 8 d, no anamorph produced.

SPECIMENS EXAMINED: U.S.A.: Hawaii, Kona district, Waimea, on a living leaves of *Leucospermum* hybrid 24, 17th Nov. 1998, P.W. Crous & M.E. Palm (JT578, PREM 56953, STE-U 2158-2160); *ibid.*, on living leaves of *Protea* ‘Pink Ice’, (JT567, PREM 56947); *ibid.*, on living leaves of *Protea neriifolia*, (JT590, PREM 56960); *ibid.*, on living leaves of *Leucospermum* hybrid 31, (JT560, PREM 56943).

ANAMORPH: Unknown.

HOST RANGE: Plurivorous (Aptroot 1998), *Leucospermum* hybrid 24, *Leucospermum* hybrid 31, *Protea* ‘Pink Ice’, *Protea neriifolia.*

GEOGRAPHIC DISTRIBUTION: Widespread (Aptroot 1998).

NOTES: These collections are somewhat atypical of *M. rubi*, in that the ascomata possess slit-like, rather than pore-like ostioles, but A. Aptroot (pers. comm.) confirmed this identification. *Lophiostoma* Ces. & De Not. has slit-like ostioles, but the characteristics of the peridium differ in this genus and the ascospores lack a sheath (Holm and Holm 1988). The collections also show some affinities with *Lophiotrema* Sacc., and the vagueness of the differences between

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Figs. 12–18. *Massarina rubi* (PREM 56953). Fig. 12. Ascomata in cross section. Fig. 13. Peridium. Fig. 14. Pseudoparaphyses. Figs. 15 and 16. Asci. Figs. 17 and 18. Ascospores with sheath (arrowed). Scale bars: 12 = 50 µm; 13–18 = 10 µm.

Lophiotrema and *Massarina* Sacc. have been noted by Holm and Holm (1988). The two genera differ in that *Lophiotrema* spp. have cylindrical asci. This fungus is probably a saprobe on necrotic tissue, but is treated here as it is commonly collected on *Proteaceae.*

Mycosphaerella holualoana Crous, Joa.E.Taylor & M.E.Palm, sp. nov.

Figs. 19–21, 41 and 42

Pseudothecia amphigena, nigra, subepidermalia, erumpentia, globosa ad subglobosa, 50–90 µm lata, and 60–90 µm alta. Asci fasciculati, bitunicati, ellipsoidei, recti vel curvati, 30–45 × 8–10 µm. Ascosporae tri- ad multiseriatae, imbricatae, hyalinae, guttulatae, parietibus tennibus, rectae, fusoideo-ellipsoideae, apicibus obtusis, latissimae in medium cellulae apicalis, mediano 1-septatae, (12–)13.5–15 × 2.5–3 µm.

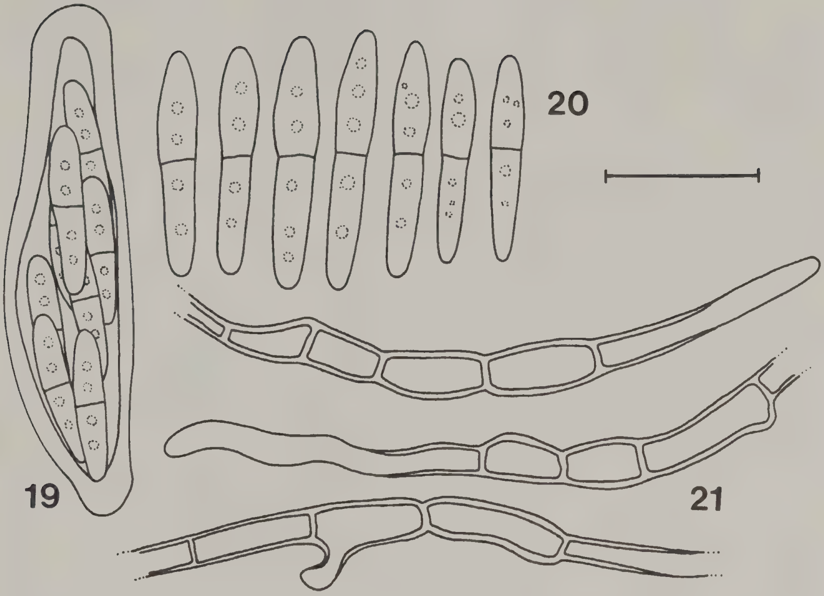
ETYMOLOGY: From Holualoa in Hawaii, where the fungus was collected.

Leaf spots inconspicuous, pseudothecia dense, aggregated in round clusters, fruiting on necrotic leaves attached to bushes. Ascomata amphigenous, black, subepidermal, substomatal, becoming erumpent; in section globose to subglobose, 50–90 µm wide, and 60–90 µm high, apical ostiole 5–10 µm wide; wall consisting of 2–3 layers of medium brown textura angularis (Fig. 42). Asci aparaphysate, fasciculate, bitunicate, subsessile, narrowly ellipsoidal, straight to slightly curved, narrowing to a rounded apex, lacking an ocular chamber, 8-spored, 30–45 × 8–10 µm (Fig. 19). Ascospores tri- to multiseriate, hyaline, guttulate, thin-walled, straight to slightly curved, fusoid-ellipsoidal with obtuse ends, widest in middle of apical cell, medianly 1-septate, not constricted at the septum, tapering towards both ends, but more prominently towards the lower end, (12–)13.5–15 × 2.5–3 µm; frequently surrounded by a mucous sheath (Figs. 20 and 41). Ascospore germination on MEA after 24 hr occurred from both ends of the ascospore, with tubes parallel to the long axis of the spore, becoming slightly constricted and distorted after 24 hr, with additional lateral branches appearing thereafter; germinating ascospores hyaline, 3–4 µm wide (Fig. 21).

CULTURAL CHARACTERISTICS: Colonies raised, uneven, with lobed margins; aerial mycelium sparse, surface olivaceous grey (23””’1), reverse greenish black (33””’k). Colonies reaching 27.5 mm diam. after 14 d. No anamorph was produced in culture, but red crystals frequently developed in the agar.

HOLOTYPE: U.S.A.: Hawaii, Kona district, Holualoa, on a living leaf of *Leucospermum* sp., 17th Nov. 1998, P.W. Crous & M.E. Palm (JT 533, PREM 56926, ex-type cultures STE-U 2126–2128).

ADDITIONAL SPECIMENS EXAMINED: U.S.A.: Hawaii, Kona district, Holualoa, on a living leaf of *Leucospermum* sp., 17th Nov. 1998, P.W. Crous & M.E. Palm (JT 609, PREM 56970, STE-U 2155–2157, 2161–2163, 2152–2154).



Figs. 19–21. *Mycosphaerella holualoana* (holotype). Fig. 19. Ascus. Fig. 20. Ascospores. Fig. 21. Germinating ascospores. Scale bar: 19–21 = 10 µm.

ANAMORPH: None observed.

HOST RANGE: *Leucospermum* spp.

GEOGRAPHIC DISTRIBUTION: U.S.A. (Hawaii).

NOTES: This species is chiefly distinguished from the other two species described below by having longer ascospores that have a distinctly different taper. No anamorph was observed on the host or in culture.

Mycosphaerella konae Crous, Joa.E.Taylor & M.E.Palm, sp. nov. Figs. 22–26, 27–31

Anamorph: ***Pseudocercospora*** sp.

Pseudothecia amphigena, nigra, subepidermalia, erumpentia, globosa ad subglobosa, ad 90 µm lata et 100 µm alta. Asci fasciculati, bitunicati, ellipsoidei, cylindri, recti vel curvati, 25–40 × 6–8 µm. Ascosporae tri- ad multiseriatae, imbricatae, hyalinae, guttulatae, parietibus tennibus, rectae, fusoideo-ellipsoideae, apicibus obtusis, latissimae in medium cellulae apicalis, mediano 1-septatae, (7–)8–10(–12) × (2.5–)3 µm.

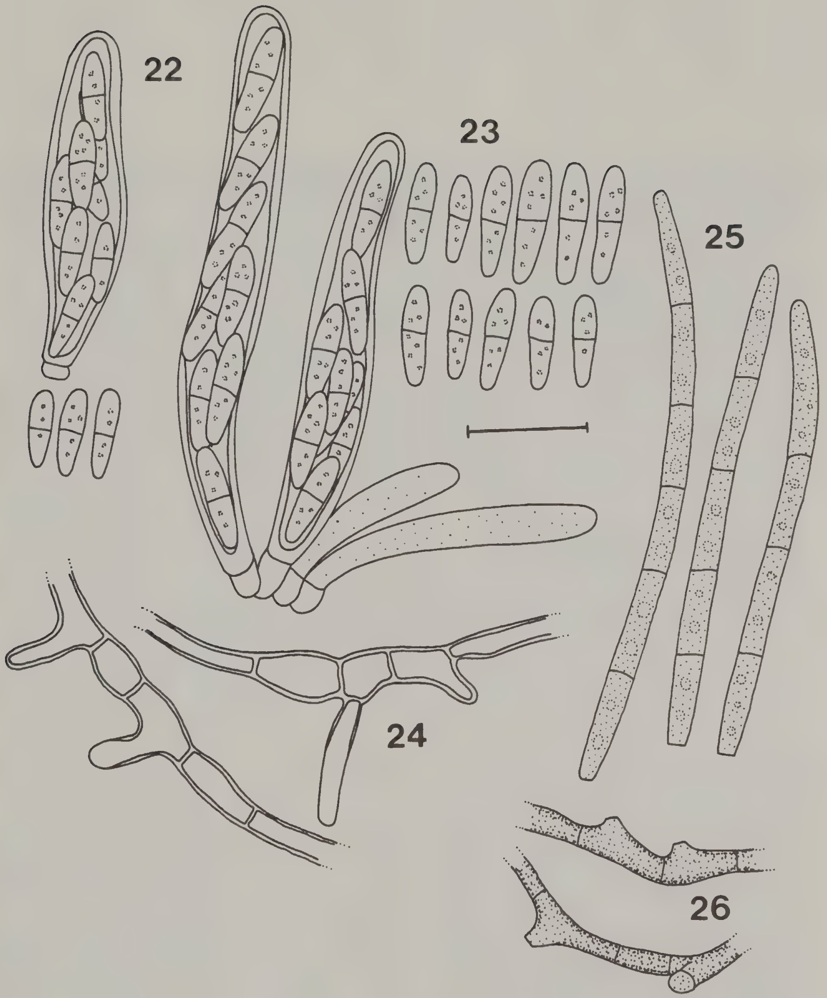
ETYMOLOGY: From the Kona district in Hawaii, where the fungus was collected.

Leaf spots inconspicuous, pseudothecia associated with tip blight and necrotic leaves still attached to bushes. Ascomata amphigenous, black, subepidermal, substomatal, becoming erumpent, aggregated in dense clusters; in section globose, up to 90 µm wide, and 100 µm high, apical ostiole 5–15 µm wide (Fig. 27); wall consisting of 2–3 layers of medium brown textura angularis; older pseudothecia developing extensive stromatic tissue (apical and lateral) (Fig. 27). Asci aparaphysate, fasciculate, bitunicate, subsessile, narrowly ellipsoidal to cylindrical, straight to slightly curved, narrowing to a rounded apex, lacking an ocular chamber, 8-spored, 25–40 × 6–8 µm (Fig. 22 and 29). Ascospores tri- to multiseriate, hyaline, guttulate, thin-walled, straight, fusoid-ellipsoidal with obtuse ends, widest in middle of apical cell, medianly 1-septate, not constricted at the septum, tapering towards both ends, but more prominently towards the lower end, (7–)8–10(–12) × (2.5–)3 µm in vivo; 7–9 × 3 µm in vitro (Figs. 23 and 30). Ascospores germination from both ends, with tubes parallel to the long axis of the spore, becoming constricted and distorted, with additional lateral branches appearing after 24 hr; germinating ascospores hyaline, 3–4 µm wide (Fig. 24). Mycelium internal and external, branched, septate, smooth, olivaceous to pale brown, hyphae 1.5–3 µm wide. Conidiophores reduced to conidiogenous cells, integrated with mycelium, smooth, pale brown, loci up to 3 µm wide, 5 µm tall, scars inconspicuous (Figs. 26 and 31). Conidia solitary, smooth, pale brown, guttulate, straight or strongly curved, frequently constricted at septa, subcylindrical, apex obtuse to subobtuse, base truncate, rarely narrowly obclavate, 1–6 septate, 15–60 × 2–3 µm; hila inconspicuous (Figs. 25 and 28).

CULTURAL CHARACTERISTICS: Colonies circular with smooth, uneven margins, with radiating striations in the agar; aerial mycelium sparse, surface iron grey (23”"’k). Colonies reaching 21 mm diam. after 14 d. The anamorph was produced in culture, but not observed on the host.

HOLOTYPE: U.S.A.: Hawaii, Kona district, Holualoa, on a living leaf on *Leucadendron* 'Safari Sunset', 17th Nov. 1998, P.W. Crous & M.E. Palm (JT 526, PREM 56921, ex-type cultures STE-U 2123–2125).

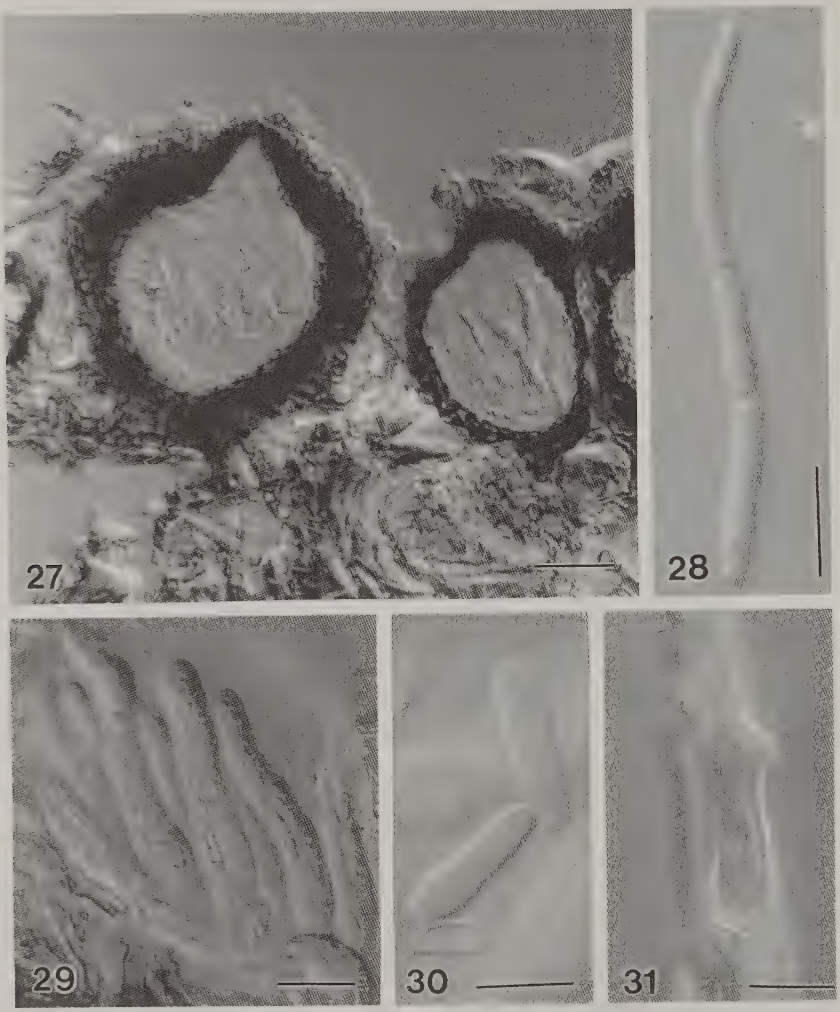
ADDITIONAL SPECIMENS EXAMINED: U.S.A.: Hawaii, Kona district, Waimea, on a living leaf of *Leucospermum* sp., 17th Nov. 1998, P.W. Crous & M.E. Palm (JT 607, PREM 56969); *ibid.*, Kona district, Hualalai, on a living leaf of *Leucospermum* 'Yellow Bird', (JT 655, PREM 57001); *ibid.*, on a living leaf of *Protea* 'Mink', (JT 662, PREM 57006); *ibid.*, on a living leaf of *Telopea* sp., (JT 669, PREM 57008); *ibid.*, on living leaf of *Banksia* sp., (JT 711, PREM 57023); *ibid.*, Kona district, Holualoa, on a living leaf of *Leucospermum* sp., (JT 693, PREM 57014); *ibid.*, on a living leaf of *Leucospermum* sp.,



Figs. 22–26. *Mycosphaerella konae* (holotype) and *Pseudocercospora* sp. Fig. 22. Asci. Fig. 23. Ascospores. Fig. 24. Germinating ascospores. Fig. 25. Conidia. Fig. 26. Conidiogenous cells. Scale bars: 22–26 = 10 µm.

(JT 720, PREM 57029); *ibid.*, Maui, on living leaf of *Leucospermum* sp., (JT 697, PREM 57017); *ibid.*, on living leaf of *Leucospermum* hybrid 24, (JT 793, PREM 57078); *ibid.*, Maui, on a living leaf of *Banksia dryandroides* Baxter ex Sweet, (JT 758, PREM 57053).

ANAMORPH: *Pseudocercospora* sp.



Figs. 27–31. *Mycosphaerella konae* (holotype). Fig. 27. Ascomata in cross section. Fig. 28. Conidium of *Pseudocercospora* sp. Fig. 29. Asci. Fig. 30. Ascospores. Fig. 31. Conidiogenous cell of *Pseudocercospora* sp. Scale bars: 27 = 20 µm; 28 and 29, 31 = 10 µm; 30 = 5 µm.

HOST RANGE: *Banksia dryandroides*, *Banksia* sp., *Leucadendron* 'Safari Sunset', *Leucospermum* 'Yellow Bird', *Leucospermum* hybrid 24, *Leucospermum* spp., *Protea* 'Mink', *Telopea* sp.

GEOGRAPHIC DISTRIBUTION: U.S.A. (Hawaii).

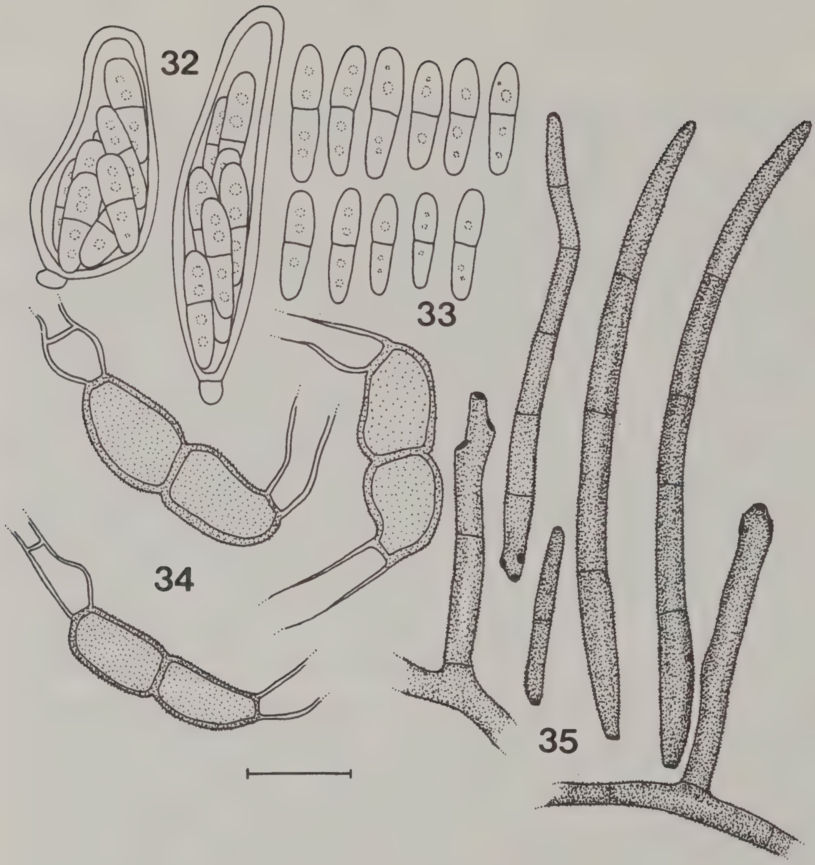
Mycosphaerella waimeana Crous, Joa.E.Taylor & M.E.Palm, sp. nov. Figs. 32–35, 36–40

Anamorph: ***Stenella*** sp.

Pseudothecia amphigena, nigra, subepidermalia, erumpentia, globosa ad subglobosa, 40–90 μm lata, and 50–90 μm alta. Asci fasciculati, bitunicati, ellipsoidei, recti vel curvati, 25–35 × 7–9 μm. Ascosporae tri- ad multiseriatae, imbricatae, hyalinae, guttulatae, parietibus tennibus, rectae, fusoideo-ellipsoideae, apicibus obtusis, latissimae in medium cellulae apicalis, mediano 1-septatae, (9–)10–11(–12) × (2.5–)3 μm.

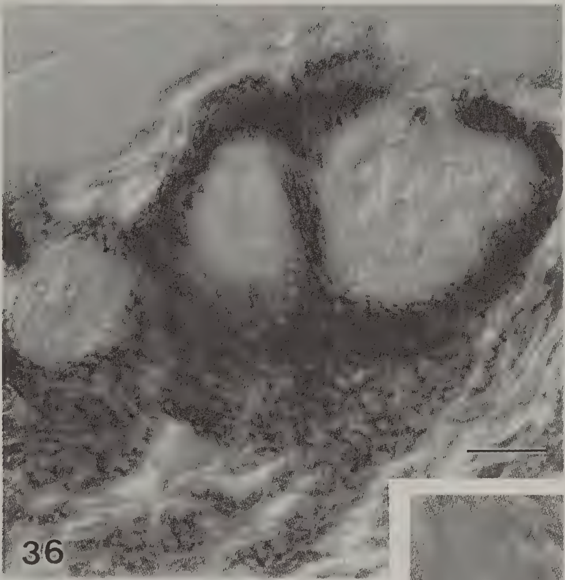
ETYMOLOGY: From the Waimea district in Hawaii, where this fungus was collected.

Leaf spots amphigenous, irregular to sub-circular, 1–5 mm diam, grey to light brown, with raised borders and purple margins; pseudothecia also sporulating on necrotic leaves attached to bushes. Ascomata amphigenous, black, subepidermal, substomatal, becoming erumpent, frequently aggregated in dense clusters (on necrotic leaves); in section globose to subglobose, 40–90 μm wide, 50–90 μm high, apical ostiole 5–15 μm wide; wall consisting of 2–3 layers of medium brown textura angularis (Fig. 36); older pseudothecia developing additional stromatic tissue around the ostiolar area (Fig. 36). Asci aparaphysate, fasciculate, bitunicate, subsessile, obovoid to broadly ellipsoidal, straight to slightly curved, narrowing to a rounded apex, lacking an ocular chamber, 8-spored, 25–35 × 7–9 μm (Figs. 32 and 40). Ascospores tri- to multiseriate, hyaline, guttulate, mostly with two large guttules per cell, thin-walled, straight to slightly curved, fusoid-ellipsoidal with obtuse ends, widest in middle of apical cell, medianly 1-septate, slightly constricted at the septum, tapering towards both ends, but more prominently towards the lower end, (9–)10–11(–12) × (2.5–)3 μm (Figs. 33 and 39). Ascospore germination from both ends of the spore not parallel to the long axis of the spore, but at various angles, mostly 90°, becoming light brown after 24 hr, verruculose (spore only), and distorting, 6-7 μm wide (Figs. 34 and 38). Mycelium internal and external, branched, septate, medium brown, verruculose, hyphae 2–3 μm wide. Conidiophores arising singly from superficial mycelium, 25–40 × 3–4 μm, 0–2-septate, subcylindrical, straight to variously curved, unbranched or branched above (Fig. 35). Conidiogenous cells terminal, unbranched, medium



Figs. 32–35. *Mycosphaerella waimeana* (holotype) and *Stenella* sp. Fig. 32. Asci. Fig. 33. Ascospores. Fig. 34. Germinating ascospores. Fig. 35. Conidia. and conidiogenous cells. Scale bars: 32–35 = 10 µm.

Figs. 36–42. *Mycosphaerella* spp. Figs. 36–40. *Mycosphaerella waimeana* (holotype). Fig. 36. Ascomata in cross section. Fig. 37. Conidium of *Stenella* sp. Fig. 38. Germinating ascospore. Fig. 39. Ascospores. Fig. 40. Ascus. Figs. 41–42. *Mycosphaerella holualoana* (holotype). Fig. 41. Ascospores. Fig. 42. Ascomata in cross section. Scale bars: 36 and 42 = 20 µm; 38, 40 and 41 = 10 µm; 37 and 39 = 5 µm.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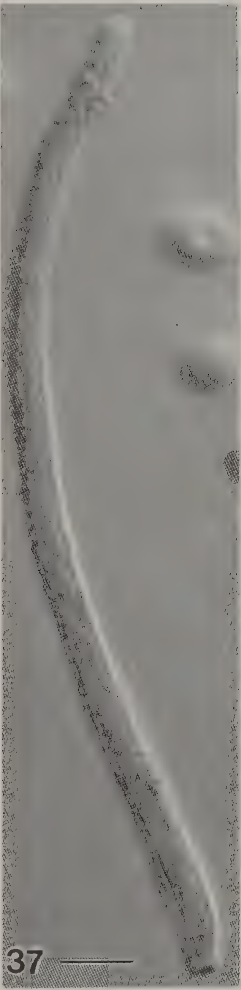
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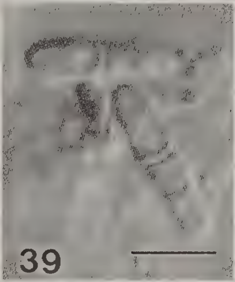
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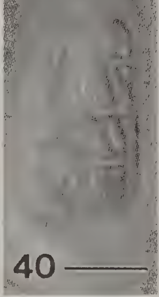
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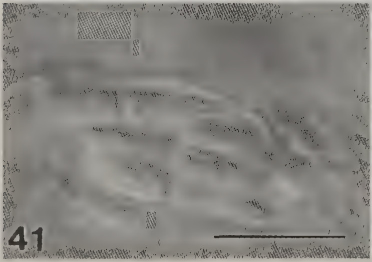
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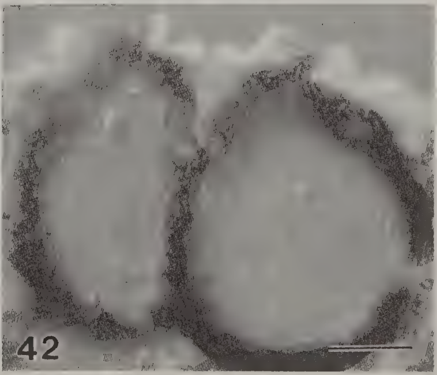
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brown, verruculose, tapering to flat-tipped or rounded apical loci, proliferating sympodially, 10–30 x 3–4 µm; loci thickened, darkened and refractive (Fig. 35). Conidia solitary, verruculose, medium brown, straight or curved, narrowly obclavate, apex subobtuse, base long obconically subtruncate, 1–11 septate, 25–100 × 3–3.5 µm; hila thickened, darkened and refractive (Figs. 35 and 37).

CULTURAL CHARACTERISTICS: Colonies circular with smooth, but uneven margins, raised, forming radiating striations in agar; aerial mycelium sparse, surface olivaceous grey (23""'b), olivaceous black (25""m) in reverse. Colonies reaching 20 mm diam. after 14 d. The anamorph was produced in culture, and also observed on the host.

HOLOTYPE: U.S.A.: Hawaii, Kona district, Waimea, on a living leaf of *Leucospermum* hybrid 24, 17th Nov. 1998, P.W. Crous & M.E. Palm (JT 575, PREM 56950, ex-type cultures STE-U 2179–2181).

ADDITIONAL SPECIMENS EXAMINED: U.S.A.: Hawaii, Kona district, Waimea, on a living leaf of *Leucospermum* sp., 17th Nov. 1998, P.W. Crous & M.E. Palm (JT 521, PREM 56918, STE-U 2164–2166); *ibid.*, (JT 523, PREM 56919, STE-U 2115–2117).

ANAMORPH: *Stenella* sp.

HOST RANGE: *Leucospermum* hybrid 24, *Leucospermum* spp.

GEOGRAPHIC DISTRIBUTION: U.S.A. (Hawaii).

NOTES: Three new species of *Mycosphaerella* are described in the present study, namely *M. holualoana*, *M. konae* and *M. waimeana*. Although morphologically similar to other species known from *Proteaceae* (Taylor and Crous 2000, Taylor et al. 2001), they can be distinguished once characteristics such as ascospore germination patterns and anamorph morphology are taken into consideration. Although the species newly described here are not known from *Proteaceae* in South Africa, it is quite likely that they have been introduced into Hawaii with *Proteaceae* from Australia. A preliminary survey (Crous et al. 2000, Crous et al. unpubl. data) has shown that there are several undescribed *Mycosphaerella* spp. occurring on *Proteaceae* in Australia, and further surveys may well reveal the presence of the taxa dealt with here on similar hosts in Australia. Alternatively, the possibility can also not be dismissed that these fungi may not be host specific, in which case further surveys in Hawaii may reveal these taxa to occur on other host families. Too few collections are available at present, however, to prove either theory.

A key to *Mycosphaerella* species associated with *Protea*, *Leucospermum* and *Leucadendron*

1. Ascospores mostly > 13 µm long..2
1. Ascospores mostly < 13 µm long..4

2. Ascospores up to 15 µm long and 3 µm wide, frequently with a mucous sheath.. *M. holuoloana*
2. Ascospores longer than 15 µm, without a mucous sheath......3
3. Ascospores fusiform, up to 25 µm long, 3.5–4(–5) µm wide, with slightly longer basal cell............ *M. jonkershoekensis* P.S. van Wyk, Marasas & Knox. Dav.
3. Ascospores fusoid-ellipsoidal, up to 20 µm long, (4–)5–6(–7) µm wide, medianly septate .... *M. leucospermi* Crous & Joa.E.Taylor
4. Ascospores surrounded by a uniformly wide, mucilaginous sheath (4–6 µm) when viewed in water .... *M. bellula* Crous & M.J. Wingf.
4. Ascospores not surrounded by a sheath when viewed in water 5
5. Ascomata formed in a well-developed stroma, ascospores up to 4 µm wide, anamorph lacking darkened, refractive dehiscence scars on the conidiogenous cells or conidia (ie. *Pseudocercospora* sp.)... *M. stromatosa* Joa.E.Taylor & Crous
5. Ascomata not formed in a stroma, ascospores less than 3.5 µm wide, anamorph lacking or with darkened, refractive dehiscence scars on the conidiogenous cells or conidia.........6
6. Ascospores widest just above septum, thick-walled on *Protea* and *Leucospermum* ... *Mycosphaerella* sp. (Taylor et al. 2001)
6. Ascospores widest in middle of apical cell, thin-walled 7
7. Ascospores slightly constricted at septum, becoming light brown at germination, germ tubes not parallel to the long axis of the spore, anamorph with darkened, refractive dehiscence scars on the conidiogenous cells or conidia (ie *Stenella* sp.) .... *M. waimeana*
7. Ascospores not constricted at septum, remaining hyaline at germination, germ tubes parallel to long axis of spore, anamorph lacking darkened, refractive dehiscence scars on the conidiogenous cells or conidia (ie. *Pseudocercospora* sp.)....... .... *M. konae*

Phyllosticta telopeae Yip, Mycol. Res. 93: 494. 1989.

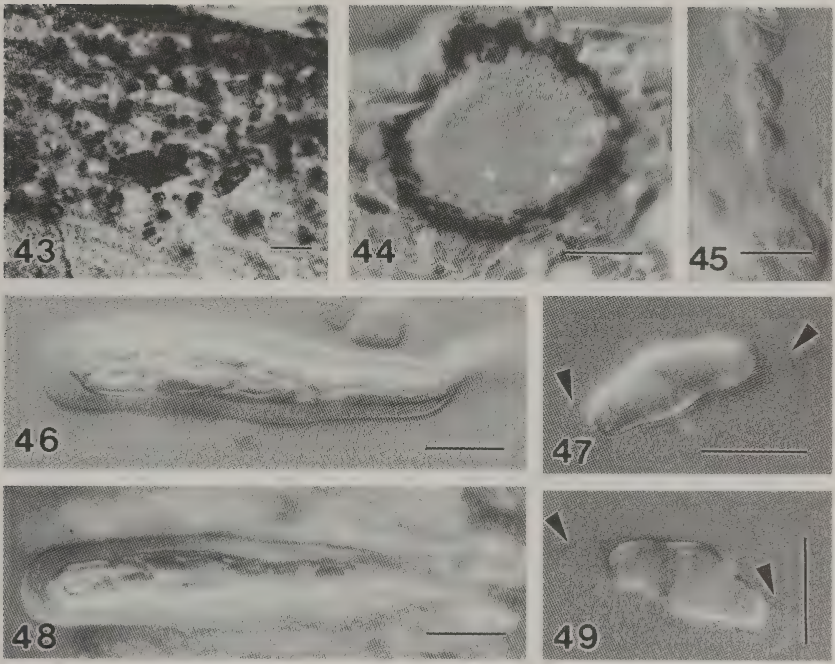
Figs. 50–57

Teleomorph: ***Guignardia*** sp.

Figs. 43–49

Leaf spots necrotic, yellow-brown, often with whole leaves affected, ascomata visible as raised, slightly darkened spots, mainly in discrete groups (Fig. 43). Ascomata amphigenous, subepidermal, substomatal, immersed becoming erumpent, visible as a slightly raised, darkened area, often with a pale centre, apapillate, 130–200 µm diam. (Fig. 43); in section globose to pyriform, often irregularly shaped, unilocular, central ostiole forming by dehiscence when mature, asci attached to the basal peridium, 143–252 µm high × 138–213 µm diam. (Fig. 44). Peridium comprising three strata, an outer stratum of thick-walled, small lumened, brown cells in a textura angularis, becoming thin-walled with larger lumens in the middle, with an inner stratum of thin-walled, hyaline textura angularis, 14–45 µm diam. Stroma well developed, comprising host cells and thick-walled dark brown fungal hyphae surrounding the ascomata, sometimes reduced to the peridium surrounding the locule. Pseudoparaphyses pseudoparenchymous, comprising rounded cells, hyaline (Fig. 45). Asci clavate, with a wide, slightly squared apex, tapering gradually to a small pedicel, bitunicate, with a well developed ocular chamber, 8-spored, 58–77 × 11–15 µm (Figs. 46 and 48). Ascospores limoniform, sometimes slightly elongated, aseptate, hyaline, thick-walled, refractive with a large central guttule, and large mucilaginous appendages, 3.5 µm wide at the apices, overlapping biseriate, 15–15.5(–17) × 5–5.5(–6) µm (Figs. 47 and 49). Conidiomata on the same leaf spots as the teleomorph, visible as raised, slightly darkened spots, scattered or in discrete groups (Fig. 50); in section substomatal, subepidermal, unilocular, globose, immersed in a sparse stroma comprising host cells and dark brown, smooth-walled fungal hyphae, 70–110 µm high × 75–110 µm diam. (Fig. 53). Peridium comprising two strata, composed of thick-walled, small lumened, brown cells in a textura angularis, with one layer of thin-walled, hyaline cells inwardly, 20–30 µm (Fig. 56). Conidiophores reduced to conidiogenous cells. Conidiogenous cells cylindrical, hyaline, holoblastic with percurrent proliferations forming 1-3 annellides, 6–18 × 2.5–4 µm (Fig. 51). Conidia ovoid to obovoid, sometimes slightly constricted at the centre, apex rounded, base with an inconspicuous flattened scar, hyaline, guttulate, often with a large guttule and many smaller ones, (8–)9–11(–14) × (5–)5.5–6.5(–9) µm, surrounded by a distinct mucilaginous sheath (2 µm wide), with a single, unbranched apical mucoid appendage that tapers to a bluntly rounded tip, (6–18 µm long) (Figs. 54 and 57). Spermatia hyaline, oblong to bone-shaped, 4.5–6 × 1.5–2 µm (Figs. 52 and 55).

CULTURAL CHARACTERISTICS: Colonies irregular in outline with fimbriate margins, greenish black, same in reverse. Dense aerial



Figs. 43–49. *Guignardia* sp. (PREM 57130). Fig. 43. Ascomata on host substrate. Fig. 44. Ascoma in cross section. Fig. 45. Pseudoparenchymous pseudoparaphyses. Figs. 46 and 48. Asci. Figs. 47 and 49. Ascospores with mucilaginous appendages (arrowed). Scale bars: 43 = 200 µm; 44 = 50 µm; 45–49 = 10 µm.

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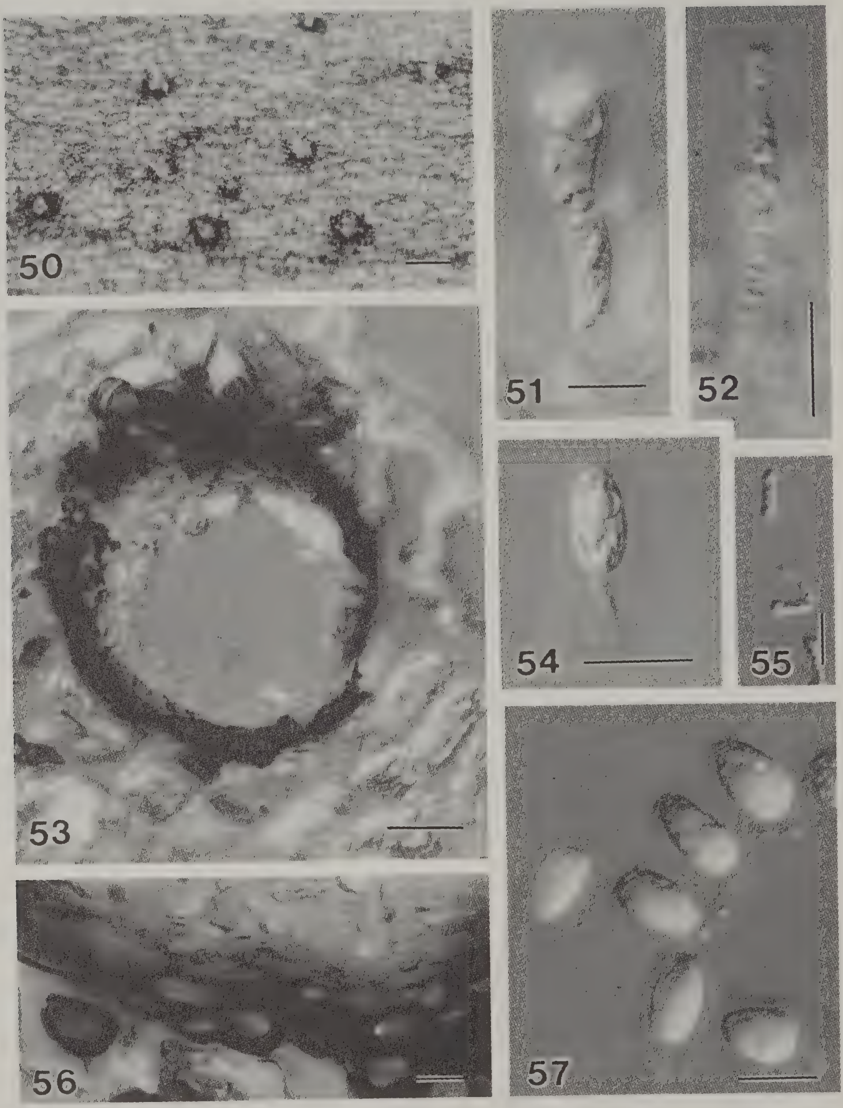
mycelium with a granulose appearance. Colonies reaching 20 mm diam. in 14 d, fertile, producing both anamorph and teleomorph.

SPECIMENS EXAMINED: U.S.A.: Hawaii, Kona district, Holualoa, on living leaves of *Protea cynaroides* (L.) L., 17th Nov. 1998, P.W. Crous & M.E. Palm (JT517, PREM 56917, STE-U 2150-2151, 2176-2178); *ibid.*, on living leaves of *Leucospermum* sp., (JT534, PREM 56927); *ibid.*, (JT719, PREM 57028); *ibid.*, on living leaves of *Leucospermum* hybrid 24, (JT537, PREM 56930); *ibid.*, on living leaves of *Leucadendron* 'Safari Sunset', (JT724, PREM 57031); *ibid.*, on living leaves of *Telopea* sp., (JT700, PREM 57019, STE-U 2172); *ibid.*, Kona district, Waimea, on living leaves of *Leucospermum* hybrid 24, (JT581, PREM 56955); *ibid.*, on living leaves of *Leucospermum* 'High Gold', (JT620, PREM 56978); *ibid.*, (JT624, PREM 56982); *ibid.*, on living leaves of *Leucadendron* 'Safari Sunset', (JT725, PREM 57032); *ibid.*, on living leaves of *Protea cynaroides* (JT603, PREM 57130, STE-U 2121-2122); *ibid,* (JT599, PREM 57131); *ibid.*, Kona district, Hualalai, on living leaves of *Protea* 'Pink Ice', 19 Nov.



Figs. 50–57. *Phyllosticta telopeae* (PREM 57131). Fig. 50. Conidiomata on host substrate. Fig. 51. Conidiogenous cell. Fig. 52. Spermatial conidiogenous cell. Fig. 53. Conidioma in cross section. Fig. 54. Conidium from host. Fig. 55. Spermatia. Fig. 56. Peridium. Fig. 57. Conidia in culture (STE-U 2121). Scale bars: 50 = 200 µm; 53 = 20 µm; 51, 54, 56 and 57 = 10 µm; 52 and 55 = 5 µm.

1998, (JT658, PREM 57004); *ibid.*, on living leaves of *Telopea* sp., (JT667, PREM 57007); *ibid.*, on living leaves of *Protea cynaroides*, (JT676, PREM 57011); *ibid.*, on living leaves of *Leucadendron* sp., (JT707, PREM 57021, STE-U 2109-2111, 2138-2140); *ibid.*, on living leaves of *Leucadendron* 'Coral', (JT715, PREM 57027); *ibid.*, Maui, on living leaves of *Banksia dryandroides* (JT759, PREM 57054); *ibid.*, on living leaves of *Protea cynaroides*, (JT788, PREM 57075); *ibid.*, on living leaves of *Leucospermum* hybrid 24, (JT792, PREM 57077).

HOST RANGE: Plurivorous (G. Carroll, pers. comm.), including *Banksia dryandroides*, *Leucadendron* 'Coral', *Leucadendron* 'Safari Sunset', *Leucadendron* sp., *Leucospermum* 'High Gold', *Leucospermum* hybrid 24, *Leucospermum* spp., *Protea cynaroides, Protea* 'Pink Ice', *Telopea* sp., and *Telopea speciosissma* (Sm.) R. Br. (Yip 1989).

GEOGRAPHIC DISTRIBUTION: Widespread (G. Carroll, pers. comm.), including Australia (Yip 1989) and U.S.A. (Hawaii).

NOTES: Three species of *Phyllosticta* are known to occur on members of the *Proteaceae.* In South Africa, *P. owaniana* G. Winter is associated with distinctive leaf spots of *Brabejum stellatifolium* L. (Swart et al. 1998). In Australia, *P. telopeae* has been reported from *Telopea*, while a further undescribed species is known from *Banksia* (Yip 1989).

This is the first report of the *Guignardia* Viala & Ravaz teleomorph of *P. telopeae.* Both the anamorph and teleomorph states form in culture in isolations derived from conidia or ascospores. The teleomorph sporulates particularly well on V8 agar (Johnston and Booth 1983). In culture, conidia are slightly larger (8–)10–12(–16) × (4–)5–7.5(–9.5) µm, than observed in vivo.

Phylogenetic analysis of ITS sequence data of *Phyllosticta* spp., including *P. telopeae*, suggested that *P. telopeae* has a wide geographic and host range (G. Carroll, pers. comm.). Previously most *Phyllosticta* Pers. species were described with a heavy emphasis on host, but preliminary molecular data do not support the strict delimitation of species based entirely on host differences.

Physalospora hawaiiensis Joa.E.Taylor, Crous & M.E.Palm, sp. nov. Figs. 58–64

Maculae foliorum morboscentes, griseae-brunneae, ascomata sparsa et singularia. Ascomata amphigena, immersa, non-erumpentia, apapillata, 250–320 µm diam.; in sectione globosa, ostiolum sparsim periphysatum, aclypeatum, 197–300 µm altum × 245–270 µm diam. Peridium compositum e duobus stratis brunneis texturis angularibus, intro hyalinescens, 14–35 µm diam. Paraphyses similes hyphae, longiores quam asci, dissolventes maturitate, 4–7 µm diam. Asci cylindrici, unitunicati, parvo pedicellato, apice rotundato sine apparatu apicali, octospori, 52–125 × 12–22 µm. Ascosporae ellipsoideae aseptatae, hyalinae vel flavidae, laeves, imbricatae uniseriatae vel biseriatae, (14–)17.5–19(–23) × (7–)9–9.5(–11) µm, vagina mucosa, 1.5–7 µm.

ETYMOLOGY: From the Latin suffix "ensis", meaning origin or place, in reference to the place where this species was first collected.

Leaf spots necrotic, grey-brown with a raised dark brown margin, often situated at the leaf tips, ascomata visible as raised, slightly darkened spots, scattered and singular. Ascomata amphigenous, immersed, non-erumpent, visible as a slightly raised, darkened area, apapillate, but host tissue often splitting above the apex of the ascomata, 250–320 µm diam; in section globose with a minutely papillate, sparsely periphysate, central ostiole, aclypeate, but with some brown fungal hyphae in the host cells surrounding the ostiole, asci attached to the basal peridium, approximately 197–300 µm high × 245–270 µm wide (Fig. 58). Peridium comprising two strata, an outer stratum of thick-walled, brown compressed textura angularis, becoming thin-walled inwardly, with an inner layer of thin-walled, hyaline textura angularis, 14–35 µm diam. (Fig. 59). Paraphyses numerous, hyaline, tapering from base to the apex, longer than asci, dissolving at maturity, 4–7 µm diam. Asci cylindrical, unitunicate, small pedicellate, rounded apex without an apical apparatus, 8-spored, 52–125 × 12–22 µm (Figs. 60 and 61). Ascospores ellipsoidal with apex slightly pointed, aseptate, hyaline to yellowish, thick-walled, smooth, refractive with a large central guttule, overlapping uni- to biseriate, (14–)17.5–19(–23) × (7–)9–9.5(–11) µm, with a mucilaginous sheath which can sometimes be slightly wider at the poles, 1.5–7 µm wide (Figs. 62–64).

CULTURAL CHARACTERISTICS: Colonies circular with entire margins, cream (19"d) with a narrow pale brown margin (19"'i); in reverse, fine concentric rings of pale brown and cream. Moderately dense, felty aerial mycelium. Colonies reaching 25 mm diam. after 7 d. Produces fruit bodies after 7 d that remain sterile.

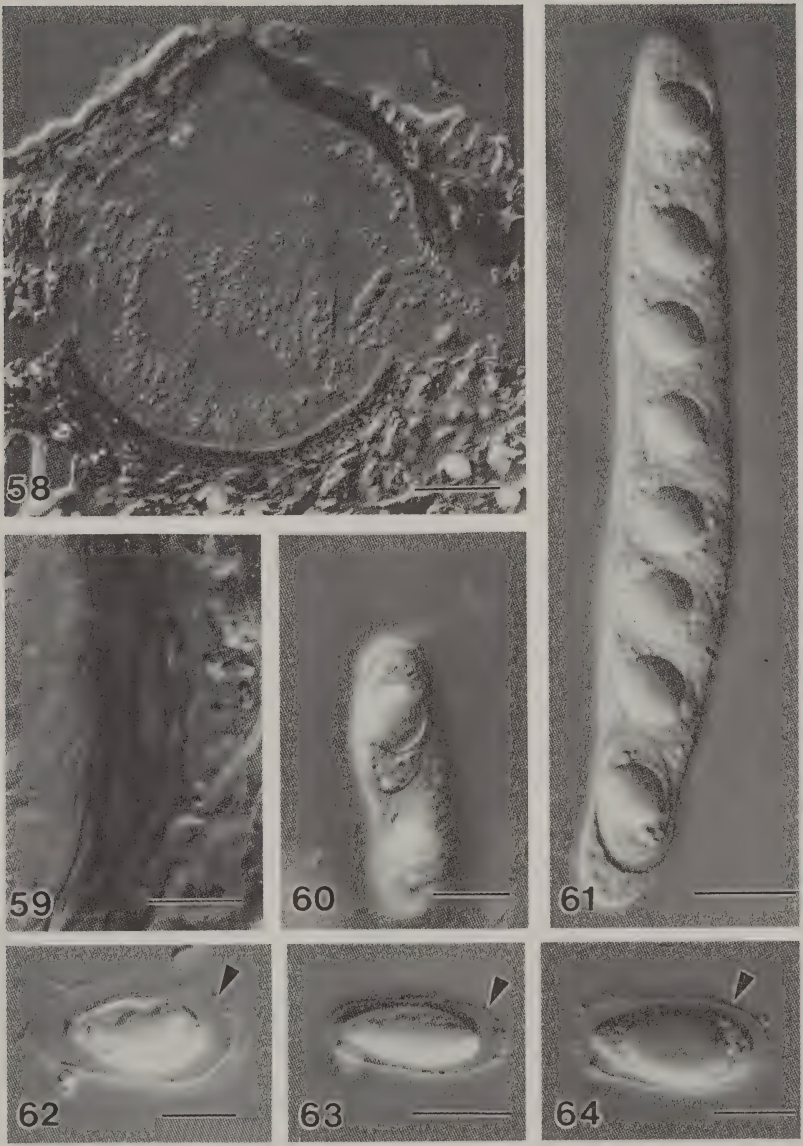
HOLOTYPE: U.S.A.: Hawaii, Kona district, Waimea, on living leaves of *Protea repens* (L.) L., 17th Nov. 1998, P.W. Crous & M.E. Palm (JT548, PREM 56936, ex-type cultures STE-U 2106–2108; Isotype IMI 380766).

ADDITIONAL SPECIMENS EXAMINED: U.S.A.: Hawaii, Kona district, Waimea, on living leaves of *Leucospermum* hybrid 24, 17th Nov. 1998, P.W. Crous & M.E. Palm (JT577, PREM 56952); *ibid.*, on living leaves of *Protea neriifolia*, (JT591, PREM 56961); *ibid.*,(JT595, PREM 56964); *ibid.*, on living leaves of *Protea cynaroides*, (JT601, PREM 56966); *ibid.*, on living leaves of *Leucospermum* 'High Gold', (JT619, PREM 56977).

ANAMORPH: Unknown.

HOST RANGE: *Leucospermum* hybrid 24, *Leucospermum* 'High Gold', *Protea cynaroides*, *Protea neriifolia, Protea repens.*

GEOGRAPHIC DISTRIBUTION: U.S.A. (Hawaii).



Figs. 58–64. *Physalospora hawaiiensis* (holotype). Fig. 58. Ascomata in cross section. Fig. 59. Peridium. Figs. 60 and 61. Asci. Figs. 62–64. Ascospores with mucilaginous sheaths (arrowed). Scale bars: 58 = 50 µm; 59 = 20 µm; 60–64 = 10 µm.

NOTES: *Physalospora* Niessl. is a widespread genus of approximately 30 species (Arx and Müller 1954; Barr 1970; Scheuer 1988; Hsieh et al. 1998) in the *Hyponectriaceae* (Hawksworth et al. 1995). Several species have been reported that have similar sized ascospores and are surrounded by sheaths, such as *Physalospora vitis-idaeae* Rehm (18–20 × 9–10.5 µm) (Barr 1970), and *P. hyalospora* (Ces.) Sacc. (16–22 × 8–11 µm) (Arx and Müller 1954). However, both generally have smaller asci and ascomata than *P. hawaiiensis*. *Physalospora palmicola* W.H. Hsieh, C.Y. Chen & Sivan. is similar to *P. hawaiiensis* in that it lacks an apical ring and in ascospore size (17–20 × 9–10 µm), but this species has distinctly verrucose ascospores (Hsieh et al. 1998). Neither *P. hawaiiensis*, nor *P. palmicola* are fully congeneric with the type *P. alpestris* Niessl., as they both lack the apical ring (which can be amyloid or non-amyloid) and the refractive apical tholus or chitinoid pulvillus (Barr 1970). In addition the ascospores of the type species have granular contents (Arx and Müller 1954), which is lacking in the aforementioned species. However, despite these differences, *P. hawaiiensis* is most closely allied to *Physalospora* (P. Cannon, pers. comm.).

Although the characters of the ascomata and ascospores are similar to those of *Glomerella* Spauld. & H. Schrenk, *Physalospora hawaiiensis* differs from the species of that genus by lacking a *Colletotrichum* Corda anamorph, which usually readily sporulates in culture. A new genus eventually could be erected to accommodate this collection and other *Phyllachora* Nitschke ex Fuckel analogues with necrotrophic/saprobic modes of nutrition, but this is pending molecular studies needed to determine relationships (P. Cannon, pers. comm.).

Stictis leucospermi Joa.E.Taylor, Crous & M.E.Palm, sp. nov.

Figs. 65–72

Apothecia partiale erumpentia, 350–500 µm diam., margo angustus vel medius, alba vel armeniaca, lacera, discus leviter urceolatus et pallide armeniacus; in sectione, 425–550 µm diam. Margo 37–92 µm latus, tristratus, sine margine prominenti accessorio thallino, paries 5–10 µm latus, compositus e cellulis compressis hyalinis pseudoparenchymatis; crystallinum stratum, bene evolutum incoloratis, heterogeneis, crystallis non rosularibus et periphysoidea 8–10 × 1.5–3 µm, non ramosa, gelatinosa; subhymenium parvis, incoloratis, cellulis angularibus J-, 12–20 µm latum. Paraphyses filiformae, simplices vel supra ramosae, vel leviter circinatae, J-, 1.5–2.5 µm latae. Asci cylindrici vel leviter fusiformes, apice truncato, octospori, pileo 2–3 µm crasso, (65–)84–93(–112) × (6–)7–8(–10) µm. Ascosporae filiformes, hyalinae, multiseptatae, cellulae 7–13 µm longae, apicibus mucosis appendiculatis, (61–)68–72(–80) × (1.5–)2(–2.5) µm.

ETYMOLOGY: In reference to the *Leucospermum* hosts.

Apothecia opening broadly by a pore, partially erumpent, 350–500 µm diam, margin narrow to medium, white to apricot, lacerate, the disc slightly urceolate and pale apricot (Fig. 65); in section, 425–550 µm diam, (Fig. 66). Margin 37–92 µm wide, three layered, without a prominent accessory thalline margin; the wall 5–10 µm wide, of compressed, hyaline pseudoparenchymatous cells; the crystaline layer consisting of well-developed colourless, heterogenous, non-rosettiform crystals and periphysoids 8–10 × 1.5–3 µm, unbranched, gelatinous; subhymenium of small, colourless angular, cells J-, 12–20 µm wide (Fig. 67). Paraphyses numerous, filiform, simple or branched above, not enlarged at apex but sometimes slightly circinate, J-, 1.5–2.5 µm wide (Fig. 72). Asci cylindrical to slightly fusiform, narrowing to a truncate apex, medium length pedicel, eight-spored, with a 2–3 µm thick cap, pierced by a narrow conical pore, (65–)84–93(–112) × (6–)7–8(–10) µm, (Figs. 68 and 69). Ascospores filiform, hyaline, multiseptate, cells 7–13 µm long, unconstricted at septa at maturity and not disarticulating, often with small mucilaginous appendages at the apices, (61–)68–72(–80) × (1.5–)2(–2.5) µm (Figs. 70 and 71).

HOLOTYPE: U.S.A.: Hawaii, Kona district, Waimea, dead leaf of *Leucospermum* sp., 17th Nov 1998, P.W. Crous & M.E. Palm, (JT524, PREM 56920).

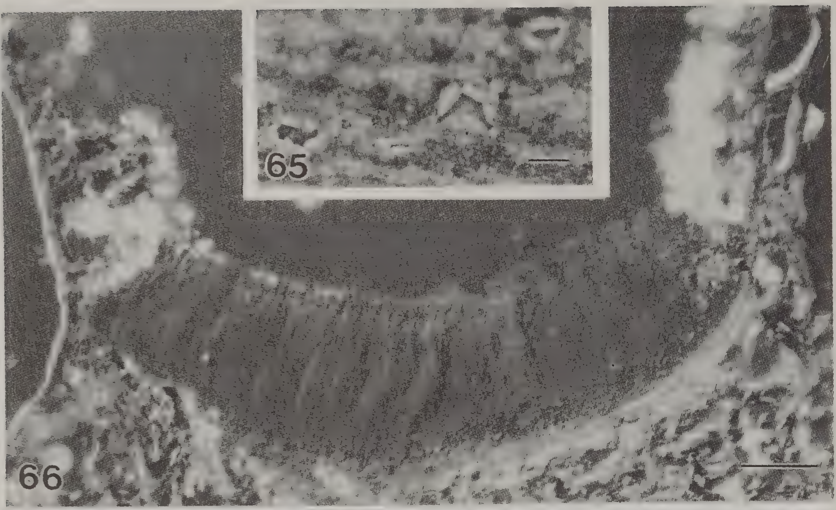
ADDITIONAL SPECIMENS EXAMINED: U.S.A.: Hawaii, Kona district, Waimea, dead leaf of *Leucospermum* hybrid 31, 17th Nov 1998, P.W. Crous & M.E. Palm (JT557, PREM 56942); *ibid.*, (JT 614, PREM 56972); *ibid.*, *Leucospermum* hybrid 24, (JT 576, PREM 56951); *ibid.*, *Leucospermum cuneiforme* x *conocarpodendron* T86-09-05, (JT618, PREM 56976); *ibid.*, *Leucospermum* 'High Gold', (JT 621, PREM 56979).

ANAMORPH: Not observed in this study, but pycnidial anamorphs have been noted in culture (Sherwood 1977).

HOST RANGE: *Leucospermum cuneiforme* x *conocarpodendron* T86-09-05, *Leucospermum* 'High Gold', *Leucospermum* hybrid 31, *Leucospermum* hybrid 24, *Leucospermum* sp.

GEOGRAPHIC DISTRIBUTION: U.S.A. (Hawaii).

NOTES: These specimens are identified as belonging to the genus *Stictis* Pers. according to Sherwood (1977) because the ascomata are apothecial with crystaline inclusions, periphysoids are present on apothecial margins and the ascospores are filiform. *S. leucospermi* is closest to *S. stellata* Wallr., in that it has more or less simple paraphyses in a J- hymenium, a small ascus cap (<5 µm thick) and non-disarticulating, filiform ascospores (Sherwood 1977). However, the asci of *S. stellata* are longer and slightly narrower, 130–200 × 6 (–8) µm, and ascospores are longer, 130–200 × 1.5–2.5 µm, with more septa and smaller cells, 3–5 µm long. In addition, *S. stellata* has distinctly stellate fruiting bodies, which are considerably different from those of *S. leucospermi.*



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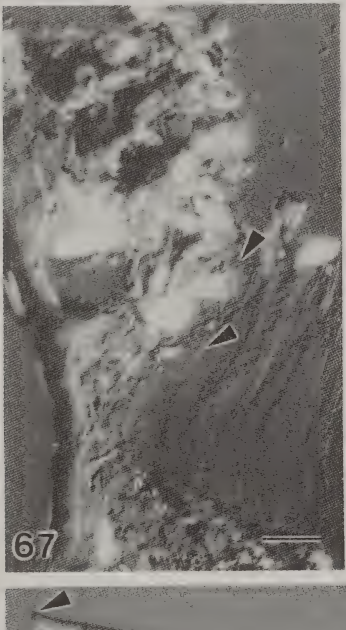

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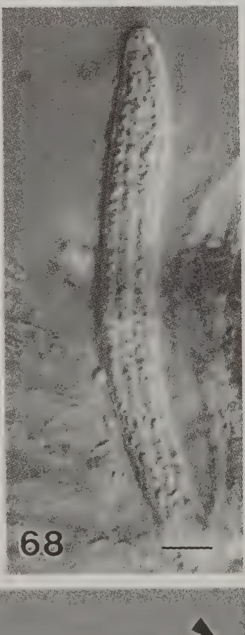

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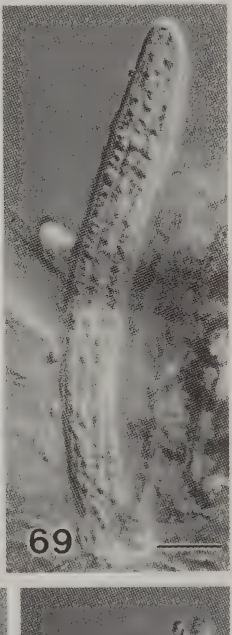

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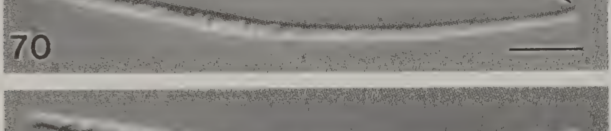

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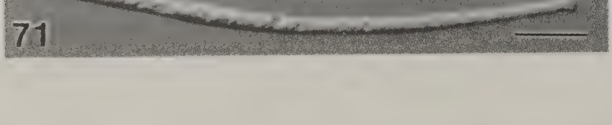

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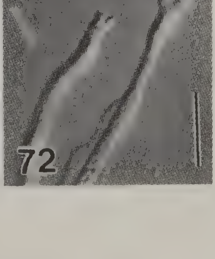

72

DISCUSSION

Fifty-six fungi associated with proteas in Hawaii are reported in this paper (Table 1). Some of these were previously reported but many are new records for Hawaii. In the past decade, research has been carried out in Hawaii on diagnosis and control of the most important diseases of proteas, namely Phytophthora root and collar rot, Elsinoë scab disease, Colletotrichum anthracnose, Rhizoctonia damping-off of seedlings, and Drechslera and Botrytis blight (Rohrbach 1983, *ibid.*, The Protea Disease Management Group, 1991, 1993). *Phytophthora cinnamomi* and *P. nicotianae* are associated with root and collar rot in Hawaii, and also Australia, whereas only *P. cinnamomi* is known from diseased proteas in South Africa. The other aforementioned diseases are associated with proteas in South Africa. However, other fungal diseases considered to be important in Hawaii, such as leaf speck caused by *Alternaria* (Fr.: Fr.) Keissl. (*ibid.,* The Protea Disease Management Group, 1993), leaf blight produced by *Calonectria colhounii* (Uchida et al. 1996; Uchida and Aragaki 1997) and root and collar rot caused by *Cylindrocladium* sp. (*ibid.,* The Protea Disease Management Group, 1993), have not been recorded in South Africa.

Palm (1999) noted that *Leptosphaeria protearum* occurred in Hawaii, and in less than a decade, Leptosphaeria blight has become devastating on some *Protea* cultivars (Stephen Ferriera, pers. comm.). Also common and widespread on plantations and occurring as new records for Hawaii were *Coleroa senniana, Botryosphaeria proteae, Fusicoccum* sp., *Phyllosticta telopeae* and *Pestalotipsis* spp. *Phyllosticta telopeae* was not recorded in the previous survey of protea diseases (*ibid.,* The Protea Disease Management Group, 1991) although it may correspond to the '*Phoma*' discussed by Rohrbach (1983). Additionally, there are few reports of Botryosphaeria dieback (*ibid.,* The Protea Disease Management Group, 1991), despite it being fairly common in the most recent survey. However, a species of

Figs. 65–72. *Sticitis leucospermi* (holotype). Fig. 65. Apothecial ascomata on host substrate. Fig. 66. Apothecial ascomata in cross section. Fig. 67. Margin, three layered, without a prominent accessory thalline margin; comprising the wall, the crystaline layer and periphysoids (arrowed). Figs. 68 and 69. Asci. Figs. 70 and 71. Ascospores with small mucilaginous appendages at the apices (arrowed in 70). Fig. 72. Paraphyses. Scale bars: 65 = 200 μm; 66 = 50 μm; 67 = 20 μm; 68–72 = 10 μm.

Dothiorella, an earlier name for the *Fusicoccum* anamorph of *Botryosphaeria* was recorded previously (*ibid.*, The Protea Disease Management Group, 1991).

New records of fungi on *Proteaceae* in Hawaii include *Massarina rubi* and *Lophiostoma fuckelii, which* are likely to be saprophytic in nectrotic lesions, and the plurivorous and widespread *Lasiodiplodia theobromae,* which has been associated with wound rot of proteas in Australia (Forsberg 1993) and is probably a weak opportunistic pathogen.

Several prevalent and undescribed leaf spot pathogens were encountered including *Mycosphaerella holualoana*, *M. konae*, and *M. waimeana, Chaetochalara proteae*, *Physalospora hawaiiensis*, *Heteroconium neriifoliae*, and *Stictis leucospermi*. However, the origin of these pathogens is uncertain. They could have been introduced on protea germplasm or may have been present in Hawaii on other hosts and "jumped" to proteas.

It is likely that the pathogens of Hawaiian proteas have various origins. Many probably were introduced from South Africa (*Coleroa senniana, Botryosphaeria proteae, Leptosphaeria protearum*) on symptomless seeds or cuttings. These species were previously only known from South Africa (Knox-Davies et al. 1987; Denman et al. 1999), and the existence of fungal pathogens in asymptomatic proteas (e.g. *Botryosphaeria proteae*) has recently been established (Swart et al. 2000). Other pathogens are probably weak, opportunistic fungi that occur on other hosts in Hawaii and have 'jumped' to protea hosts (*Lasiodiplodia theobromae*). Some pathogens are apparently Australian in their origin (*Elsinoë banksiae*, *Mycosphaerella* spp.) and have probably been introduced by similar means as the South African fungi.

The knowledge that pathogens of *Proteaceae* can exist as symptomless, latent infections suggests that it is important to develop appropriate phytosanitary regulations in order to prevent the movement of pathogens of *Proteaceae* between countries. Those regulations must promote the production of high quality, disease free material, as well as determine appropriate techniques to mitigate the risks posed by undetectable, latent pathogens. This is especially true for propagative material such as cuttings and seeds. Quarantine regulations for the U.S.A. are in place requiring cuttings to be visually disease free (N. Nagata, pers. comm.). Suppliers of seeds often advise that they are treated with a hot water treatment (50° for 30 min) and a dusting with Thiram (1gm/100 seeds). However, latent infections would not be detected by visual inspection and the efficacy of the treatments against these pathogens is uncertain. Research is

Table 1. Microfungi recorded from diseased *Proteaceae* hosts in Hawaii in November 1998. Also includes records listed in Farr et al. (1989)[1], from previous records (*ibid.*, The Protea Disease Management Group, 1991)[2], and from quarantine interceptions[3].

Pathogen	Host Range	Symptoms	Status in South Africa	References
Armillaria mellea (Vahl: Fr.) P. Kumm.	*Grevillea robusta* A. Cunn. ex R. Br. [1]	-	N	(Laemmlen and Bega 1974)
Ascochyta sp.	*Leucospermum* reflexum H. Buek ex Meisn.[2]	Leaf spot	-	(*ibid.*, The Protea Disease Management Group, 1991)
Aureobasidium sp.	*Protea laurifolia* 'Rose Mink'	Leaf spot	-	PREM 57048
Bionectria ochroleuca (Schwein.) Schroers & Samuels [*Clonostachys rosea* (Link: Fr.) Schroers et al.]	*Protea* 'Pink Ice'	On dead wood	-	PREM 57081, STE-U 2228-2229, 2277-2279
Botryosphaeria dothidea (Moug. ex Fr.) Ces. & De Not. (*Fusicoccum aesculi* Corda)	*Grevillea wilsonii* A. Cunn.	Associated with severe leaf spots and cankers	Y	PREM 56983, STE-U 2147-2149
	Leucadendron 'Safari Sunset'			PREM 56922, STE-U 2055-2056
	Leucadendron sp.			PREM 56984
	Leucospermum hybrid 31			PREM 56941
	Leucospermum 'Sunset'			PREM 56997
	Leucospermum 'Yellow Bird'			PREM 57002
	Leucospermum sp.			PREM 56924, STE-U 2051-2052
	Protea compacta 'Carnival'			PREM 57068
	Protea 'Lady Di'			PREM 57063
	Protea 'Pink Ice'			PREM 57003
	Protea cynaroides			PREM 56967, STE-U 2064-2066
	Telopea sp.			PREM 56931, STE-U 2100-2102, 2141-2143
Botryosphaeria proteae (Wakefield) S. Denman & Crous (*Fusicoccum proteae* S. Denman & Crous)	*Protea compacta* 'Carnival'	Leaf spot	Y	PREM 57067
	Protea 'Lady Di'			PREM 57060, STE-U 2271-2273
	Protea 'Mink'			PREM 56991
	Protea 'Pink Ice'			PREM 57037
	Protea cynaroides			PREM 56993, STE-U 2097-2099
	Protea laurifolia 'Rose Mink'			PREM 57049

	Protea neriifolia			PREM 57034
	Protea sp.			PREM 56988, STE-U 2169-2171
Botryosphaeria ribis Grossenb. & Duggar	*Grevillea* sp.[1, 3]	-	-	BPI 600863 (Anonymous 1960; Raabe et al. 1981)
Botryotinia fuckeliana (de Bary) Whetzel (*Botrytis cinerea* Pers.)	*Banksia menziesii* R. Br.[2] *Leucospermum cordifolium* (Salisb. ex Knight) Fourc. (also as *L. nutans*)[1] *Leucospermum* 'Pink Star'[2] *Leucospermum* hybrid 24[2] *Leucospermum* sp.[2]	Blight on flowers, leaves and shoots	Y	(Cho 1977; Raabe et al. 1981; *ibid.*, The Protea Disease Management Group, 1991)
	Protea cynaroides[2]			PREM 56916
	Protea repens[2]			
Botrytis sp.	*Protea cynaroides*[2]	Leaf blight	-	(*ibid.*, The Protea Disease Management Group, 1991)
Calonectria colhounii Peerally	*Leucospermum* spp.	Leaf blight	-	(Uchida et al. 1996; Uchida and Aragaki 1997)
Chaetochalara proteae	*Protea* 'Pink Ice'	Leaf spot	-	PREM 56948
Cladosporium sp.	*Protea* 'Rose Mink'	Leaf spot	-	PREM 57036
Coleroa senniana (Sacc.) E. Mull. & Arx	*Protea compacta* 'Carnival'	Severe leaf spot pathogen. Biotrophic, sometimes causing necrotic lesions	Y	PREM 57066
	Protea 'Lady Di'			PREM 57059
	Protea 'May Day'			PREM 57072
	Protea 'Mink'			PREM 57005
	Protea 'Pink Ice'			PREM 57041
	Protea neriifolia 'Ivory Musk'			PREM 57040
	Protea sp.			PREM 56989
Coniothyrium nitidae Crous & S. Denman	*Protea compacta* 'Carnival'	Leaf spot	Y	PREM 57071, STE-U 3464-3465
Cylindrocarpon sp.	*Leucadendron* "Safari Sunset'[2] *Leucospermum* 'Firefly'[2] *Leucospermum* hybrid 24[2]	Root rot	-	(*ibid.*, The Protea Disease Management Group, 1991)

Cylindrocladium sp.	*Banksia prionotes*[2] *Leucospermum* 'Firefly'[2] *Leucospermum* hybrid 24[2] *Leucospermum* spp.[2] *Protea cynaroides*[2] *Protea neriifolia*[2]	Root rot	-	(*ibid.*, The Protea Disease Management Group, 1991)
Dothiorella sp.	*Leucadendron laureolum* (Lam.) Fourc.[2] *Protea cynaroides*[2]	Leaf spot and stem canker	-	(*ibid.*, The Protea Disease Management Group, 1991)
Drechslera dematoidea (Bubák & Wróbl.) Subram. & Jain	*Leucospermum* 'Cloud Bank' *Leucospermum* sp. *Leucospermum* hybrid 49	Blight on leaves and new shoots	Y	PREM 57038, STE-U 2194-2196 PREM 57061, STE-U 2212-2214 PREM 57082
Drechslera & *Bipolaris* spp.	*Leucadendron* 'Safari Sunset'[2] *Leucospermum* 'Pink Star'[2] *Leucospermum* hybrid 24[2] *Leucospermum* spp.[2] *Protea cynaroides*[2] *Protea repens*[2]	Blight on flowers, leaves and stems, and associated with root rot	-	(*ibid.*, The Protea Disease Management Group, 1991)
Elsinoë banksia Pascoe & Crous (*Sphaceloma* sp.)	*Banksia* sp. *Banksia menziesii*	Scab	N	PREM 57012 PREM 56928, PREM 56929
Elsinoë leucospermi L. Swart & Crous (*Sphaceloma* sp.)	*Leucospermum* hybrid 15 *Leucospermum* hybrid 24 *Leucospermum* 'Cloud Bank' *Leucospermum* 'Ribbon' *Leucospermum* 'Sunset' *Leucospermum* sp.	Scab	Y	PREM 56974 PREM 57076 PREM 57079 PREM 56994 PREM 56996 PREM 57044
Elsinoë sp.	*Leucospermum cordifolium* 'Coral'[2] *Leucospermum cordifolium* 'Gold'[2] *Leucospermum cordifolium* 'Hawaii'[2] *Leucospermum cordifolium* hybrid 24[2] *Leucospermum* sp.[3]	Scab	-	(*ibid.*, The Protea Disease Management Group, 1991) BPI 749188

Fusicoccum sp.	*Leucospermum* 'Cloud Bank'	Leaf spot	Y	PREM 57080
	Leucospermum 'Ribbon'			PREM 56995
	Leucospermum 'Spider'			PREM 56968, STE-U 2073-2075
	Leucospermum 'Sunset'			PREM 56998
	Leucospermum hybrid 31			PREM 56944, STE-U 2070-2072
	Protea cynaroides			PREM 56965, STE-U 2067-2069
	Protea 'Lady Di'			PREM 57061
	Protea 'Pink Ice'			PREM 57046, STE-U 2218-2220
	Protea compacta 'Carnival'			PREM 57070
	Protea neriifolia			PREM 57010
	Protea laurifolia 'Rose Mink'			PREM 57050
	Telopea sp.			PREM 56940, STE-U 2112-2114
Fusicoccum sp.	*Protea* sp.[3]	Leaf spot	-	BPI 525051
Glomerella cingulata (Stoneman) Spauld. & H. Schrenk [*Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc.]	*Banksia dryandroides*	Anthracnose on leaves and shoots[2], leaf spot	Y	PREM 57057
	Leucospermum sp.			PREM 56971
	Leucadendron laureolum[2]			(*ibid.*, The Protea Disease Management Group, 1991)
	Leucospermum 'Coral'[2]			
	Leucospermum sp.[2]			
	Protea cynaroides[2]			PREM 56946, STE-U 2088-2090
	Protea neriifolia			PREM 56945
	Telopea sp.			PREM 56932, STE-U 2091-2093
Graphium sp.	*Leucadendron laureolum*[2]	Crown rot	-	(*ibid.*, The Protea Disease Management Group, 1991)
Guignardia sp. (*Phyllosticta telopeae*)	*Banksia dryandroides*	Leaf spot	N	PREM 57054
	Grevillea robusta[3]			BPI 350260
	Leucadendron 'Safari Sunset'			PREM 57031
	Leucadendron sp.			PREM 57021, PREM 57022
	Leucospermum 'Coral'			PREM 57027
	Leucospermum 'High Gold'			PREM 56978
	Leucospermum hybrid 24			PREM 56955, PREM 57077, PREM 56930
	Leucospermum sp.			PREM 56927, PREM 57028
	Protea 'Pink Ice'			PREM 57004

	Protea cynaroides			PREM 56917, STE-U 2150-2151, 2176-2178; PREM 57075, PREM 57011; PREM 57130, STE-U 2121-2122; PREM 57131
	Telopea sp.			PREM 57019, PREM 57007
Heteroconium neriifoliae	*Protea* 'Pink Ice'	Leaf spot	N	PREM 56985
	Protea neriifolia			PREM 56958, PREM 56962, PREM 56934, PREM 56987
Kabatiella sp.	*Leucospermum* sp.	Leaf spot		PREM 57045, STE-U 2280-2282
	Protea 'May Day'			PREM 57074
	Protea cynaroides			PREM 56935
Lasiodiplodia theobromae (Pat.) Griff & Maubl.	*Banksia dryandroides*	Leaf spot	N	PREM 57052
	Leucospermum sp.			PREM 57015, STE-U 2094-2096
	Protea cynaroides			PREM 57032
	Telopea sp.			PREM 57020
Lembosia sp.	*Banksia dryandroides*	Leaf spot	N	PREM 57055
Leptosphaeria protearum Syd & P. Syd. (*Coniothyrium protearum* Joa.E.Taylor & Crous)	*Protea* 'Mink'	Severe leaf spot and leaf blight	Y	PREM 56990
	Protea 'Pink Ice'			PREM 56986
	Protea 'Rose Mink'			PREM 57035
	Protea cynaroides			PREM 56992
	Protea laurifolia Thunb.			PREM 54959
	Protea neriifolia			PREM 56933
	Protea neriifolia 'Ivory Musk'			PREM 57039
	Protea susannae E. Phillips			PREM 57065
	Protea sp.			PREM 57064; PREM 57009, STE-U 11669
Lophiostoma fuckelii Sacc.	*Leucospermum* 'High Gold'	Leaf spot	Y	PREM 56980
	Leucospermum hybrid 24			PREM 56954
	Leucospermum sp.			PREM 57016
	Protea 'Lady Di'			PREM 57062
	Protea neriifolia			PREM 56963

Macrophoma sp.	*Leucospermum* sp. [2] *Protea* sp. [3]	Leaf spot	-	(*ibid.*, The Protea Disease Management Group, 1991) BPI 359948
Massarina rubi	*Leucospermum* hybrid 24 *Leucospermum* hybrid 31 *Protea* 'Pink Ice' *Protea neriifolia*	Leaf spot	N	PREM 56953 PREM 56943 PREM 56947 PREM 56960
Mycosphaerella holualoana	*Leucospermum* spp.	Leaf spot	N	PREM 56970, PREM 56926
Mycosphaerella leucadendrica (*Pseudocercospora* sp.)	*Banksia dryandroides* *Banksia* sp. *Leucadendron* 'Safari Sunset' *Leucospermum* 'Yellow Bird' *Leucospermum* hybrid 24 *Leucospermum* sp. *Protea* 'Mink' '*Telopea* sp.	Leaf spot	N	PREM 57053 PREM 57023 PREM 56921 PREM 57001 PREM 57078 PREM 57017, PREM 57014, PREM 57029, PREM 56969 PREM 57006 PREM 57008
Mycosphaerella waimeana (*Stenella* sp.)	*Leucospermum* hybrid 24 *Leucospermum* sp.	Leaf spot	N	PREM 56950 PREM 56918, PREM 56919
Mycosphaerella spp.	*Leucospermum* 'Sunset' *Protea* 'Pink Ice' *Protea* 'May Day' *Protea neriifolia*	Leaf spot	N	PREM 56999 PREM 57042 PREM 57073 PREM 56956
Nectria pseudotrichia Berk. & M.A. Curtis [*Tubercularia laterina* (Berk.) Seifert]	*Leucospermum* hybrid 24 *Leucospermum* sp.	On wood	N	PREM 56923, STE-U 2059-2060 PREM 56949
Periconia digitata (Cooke) Sacc.	*Leucospermum* 'Coral'	On leaf	N	PREM 57025

Pestalotiopsis spp.	*Leucospermum* 'Coral'	Leaf spot	-	PREM 57024, STE-U 2209-2211; PREM 57026, STE-U 2215-2217
	Leucospermum cunei x *conocarpodendron* T86-09-05			PREM 56975, STE-U 2144-2146
	Leucospermum 'High Gold'			PREM 56981, STE-U 2132-2134
	Leucospermum 'Yellow Bird'			PREM 57000, STE-U 2129-2131
	Leucospermum hybrid 15			PREM 56973
	Leucospermum hybrid 31			HKU(M) 16412
	Leucospermum sp.			HKU(M) 16411
	Protea 'Mink'			HKU(M) 16410
	Protea 'Pink Ice'			HKU(M) 16409
	Protea cynaroides			PREM 57018
	Protea repens			HKU(M) 16408
	Protea susannae			HKU(M) 16407
	Telopea sp.			HKU(M) 16406
Phoma spp.	*Leucospermum* hybrid seedling	Leaf spot, die back[1]	-	PREM 57058
	Leucospermum sp.			PREM 56925, STE-U 2173-2175
	Protea neriifolia			PREM 56959
	Protea repens			PREM 56957
	Protea sp. [1]			(Raabe et al. 1981)
Physalospora hawaiiensis	*Leucospermum* 'High Gold'	Leaf spot	N	PREM 56977
	Leucospermum hybrid 24			PREM 56952
	Protea cynaroides			PREM 56966
	Protea neriifolia			PREM 56964, PREM 56961
	Protea repens			PREM 56936
Phytophthora cinnamomi Rands	*Banksia baxteri* R. Br. [2]	Root and crown root	Y	(Cho 1981; Raabe et al. 1981; *ibid.*, The Protea Disease Management Group, 1991)
	Banksia menziesii[1]			
	Banksia speciosa R. Br. [1]			
	Leucospermum cordifoilum[1]			
	Leucospermum hybrid 24[2]			
	Protea cynaroides[1]			
	Protea sp. [1]			
Polyporus gilvus (Schwein.: Fr.) Pat.	*Grevillea robusta* [2]	Dead wood	N	BPI 209414

Pythium sp.	*Leucospermum cordifolium*[1] *Leucospermum* hybrid 24[2] *Protea neriifolia*[2] *Protea* sp. [1]	Root rot	-	(Raabe et al. 1981; *ibid.*, The Protea Disease Management Group, 1991)
Rhizoctonia sp.	*Leucospermum cordifolium*[1] *Leucospermum* hybrid 24[2] *Protea cynaroides*[2] *Protea eximia*[2] *Protea* sp.[1]	Root rot	-	(Raabe et al. 1981; *ibid.*, The Protea Disease Management Group, 1991)
Septoria grandicipis Joa.E.Taylor & Crous	*Protea compacta* 'Carnival'	Leaf spot	Y	PREM 57069
Seuratia globifera (Ellis & Everh.) Meeker	*Grevillea robusta*[1] *Grevillea* sp. [1]	Anthracnose, black leaf spot	N	(Anonymous 1960; Raabe et al. 1981)
Stemphylium sp.	*Telopea* sp.	Leaf spot	-	PREM 56939, STE-U 2085-2087
Stictis leucospermi	*Leucospermum cunei* x *conocarpodendron* T86-09-05 *Leucospermum* 'High Gold' *Leucospermum* hybrid 24 *Leucospermum* hybrid 31 *Leucospermum* sp.	Leaf spot	N	PREM 56976 PREM 56979 PREM 56951 PREM 56942, PREM 56972, PREM 56920
Zygosporium sp.	*Leucadendron* 'Safari Sunset'	Leaf spot	N	PREM 57030

necessary to determine how to produce high quality disease free material, and effectively treat latent pathogen infections in support of developing a protocol for phytosanitary certification.

In conclusion, this paper has expanded our knowledge of the fungi on proteas in Hawaii. It is apparent that a number of diseases have been introduced into Hawaii from other countries and that certain diseases are important in Hawaii that are not present or significant in other countries. Because of the current efforts to increase exchange of protea germplasm between countries, additional research on the pathogenicity, host range, and biology of these pathogens is essential for accurate risk assessments. Additionally, field collections in Hawaii, California, and South Africa should be continued and carried out at different seasons and in different years, and an increased effort should be made to determine fungal pathogens of proteas in other countries. Armed with knowledge of the fungi associated with proteas and their biological characteristics, accurate risk assessments can be conducted in order to protect native and cultivated protea resources worldwide.

ACKNOWLEDGEMENTS

Sincere thanks to Stephen Ferreira for arranging for the collecting sites and to he and Karen Pitz for their assistance in collecting in Hawaii. Thanks to Norman Nagata and Ken Leonhardt for information on protea diseases in Hawaii, and to the protea producers in Hawaii who allowed sampling to be carried out on their farms. We acknowledge the USDA-FAS-ICD-RSED grant 98IARA6578 and the South African National Research Foundation for financial support. Sarie Velthuysen (PREM) kindly accessioned herbarium specimens.

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MYCOTAXON

Volume LXXVIII, pp. 491-497 April-June 2001

A LIST OF TYPE SPECIMENS OF MICROFUNGI DESCRIBED BY P. HENNINGS HELD AT THE HERBARIUM OF INSTITUTO DE BOTÂNICA (SP)

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ABSTRACT

A list of type collections of 32 species, belonging to 13 genera, described by P. Hennings and deposited at SP, is provided.

Key words: Cercosporoids fungi, Brazil.

INTRODUCTION

The Herbarium (SP) of the "Instituto de Botânica" located in São Paulo, Brazil, was founded in 1917 (Teixeira, 1988) and includes now about 12.000 specimens and 180 types of fungi and lichenes at the "Section of Mycology and Lichenology", collected primarily from the State of São Paulo, but also from other Brazilian regions.

P. Hennings (1841-1908) dealt with material of more than 100 collectors from all parts of the world during the time of his management of the "Botanischen Centralstelle für dei Kolonien" in Berlin (Hein, 1988). Hennings examined several collections from Brazil, mainly collected by E. H. Ule who worked at the "Museo Nacional do Rio de Janeiro" and by A. Puttemans from the M. Kuhlmann Company at "Comissão Geográfica e Geológica do Estado de São Paulo" (Fidalgo, 1968). Puttemans played an important role in the history of the Brazilian phytopathology

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(Puttemans, 1940). Based on his collections, Hennings introduced five new genera and 111 new species (Martius, 1906).

Specimens collected by Puttemans have been deposited in various others Herbaria, viz. “Museo Botanico Berolinensi” (B), “Herbarium Horto Bot. Bruxellas” (BR), “Herb. Ellis (Newfield)” (now NY), “Laboratorio Pathologiae Vegetalis Parisiensi”, “Herb. Spegazzini (La Plata)” (LPS), “Escola de Farmácia de São Paulo” and “Herb. Noack” (Gernaheim) (Martius, 1906).

The present list contains names of some fungi described by Hennings (1902a, 1902b). Höhnel (1911) revised some of these species.

ARRANGEMENT OF THE LIST

The following list refers to 32 names of fungus species described by P. Hennings and their type collections deposited at SP. All taxa are alphabetically arranged. The taxa concerned have been published by Hennings (1902a, 1902b). Host names and other details of the collections are based on the original labels of the specimens deposited at SP and have been compared with the data published by Hein (1988). Deviations between the data of the collections at B and SP are noted for the species concerned or question marks (?) are used to indicate that the situation is not yet clear. An asterisk (*) indicates the type species of Cercosporoids fungus that have recently been lost on the way to Brazil from Herbarium (B) (Hein, personal communication).

LIST OF TYPE SPECIES AT HERBARIUM (SP)

Ascochyta alstoniae Hennings. Hedwigia 41: 307. 1902.

Host: on living leaves of *Alstonia scholaris*; Brazil, São Paulo, Horto Botânico, Jan. 1902, Puttemans 426.

Herbaria: B-Holotypus; SP32688 - Isotypus.

Ascochyta basellae Hennings. Hedwigia 41: 114. 1902.

Host: on living leaves of on living leaves of *Basella rubra* (?); Brazil, São Paulo, Horto Botânico, 28 May 1900, Puttemans 244.

Herbaria: B-Holotypus; SP32687 - Isotypus.

Ascochyta coffeae Hennings. Hedwigia 41: 307. 1902.

Host: on living leaves of *Coffea arabica*; Brazil, São Paulo, Horto Botânico, Dec. 1901, Puttemans 406.

Herbaria: B-Holotypus; SP32686 – Isotypus.

Aschersonia flavo-citrina Hennings. Hedwigia 41: 307. 1902.

Host: on living leaves of *Psidium* sp.; Brazil, São Paulo, Horto Botânico, Oct. 1901, Puttemans 362.

Herbaria: B-Holotypus; SP32779 – Isotypus.

Observations: In the SP exsiccatum, Kuhlmann identified the host plant as *Psidium variabile* and referred to material deposited at Kew (Comp. M.K. nº 28609).

Cercospora asclepiadis Hennings. Hedwigia 41: 309. 1902. *

Host: on living leaves of *Asclepias*; Brazil, São Paulo, Horto Botânico, Mar. 1900, Puttemans 67.

Herbaria: B-Holotypus; SP32705 – Isotypus.

Observations: In the SP exsiccatum, Kuhlmann identified the host plant as *Oxypetalum pannosum*.

Cercospora cajani Hennings. Hedwigia 41: 309. 1902. *

Host: *Cajanus indicus*; Brazil, São Paulo, Horto Botânico, May 1901, Puttemans 237.

Herbaria: B-Holotypus; SP32702 – Isotypus.

Cercospora cordylines Hennings. Hedwigia 41: 117. 1902. *

Host: on living leaves of *Cordyline dracaenoides*; Brazil, São Paulo, Horto Botânico, 16 Mar. 1901, Puttemans 286.

Herbaria: B-Holotypus; SP32701 - Isotypus.

Cercospora filicum Hennings. Hedwigia 41: 310. 1902. *

Host: on living leaves of *Nephrodium* sp; Brazil, São Paulo, Horto Botânico, 03 June 1901, Puttemans 258.

Herbaria: B-Holotypus; SP32713 - Isotypus.

Observations: In the SP exsiccatum, the host is given as *Dryopteris* sp. (?).

Cercospora puttemasii Hennings. Hedwigia 41: 117. 1902. *

Host: on living leaves of *Nycanthes arbor-tritis* (*Nyctanthes arbor-tristis*); Brazil, São Paulo, Horto Botânico, 05 July 1901, Puttemans 297.

Herbaria: B-Holotypus; SP32708 – Isotypus.

Cercospora richardsoniae Hennings. Hedwigia 41: 117. 1902. *

Host: on living leaves of *Richardsonia* sp.; Brazil, São Paulo, Horto Botânico, 04 Feb. 1901, Puttemans 166.

Herbaria: B-Holotypus; SP32709 - Isotypus.

Cercospora urostigmatis Hennings. Hedwigia 41: 117. 1902. *

Host: on living leaves of *Urostigma* sp.; Brazil, São Paulo, Serra da Cantareira, 03 Apr. 1901, Puttemans 187.

Herbaria: B-Holotypus; SP32710 - Isotypus.

Diplodia camelliae Hennings, Hedwigia 41: 114. 1902.

Host: on living leaves of *Camellia japonica*; Brazil, São Paulo, Mandaqui, 23 Apr. 1900, Puttemans 147.

Herbaria: B-Holotypus; SP29632 - Isotypus.

Epicoccum microscopicum Hennings. Hedwigia 41: 311. 1902.

Host: on living leaves of Graminaceae; Brazil, São Paulo, Horto Botânico, Nov. 1901, Puttemans 393.

Herbaria: B-Holotypus; SP32786 - Isotypus.

Observations: In the SP exsiccatum, Kuhlmann identified the host as *Croix lachryma-jobi.*

Epicoccum pandani Hennings. Hedwigia 41: 119. 1902.

Host: on leaves of *Pandanus veichii*; Brazil, São Paulo, Horto Botânico, 21 June 1901, Puttemans 278.

Herbaria: B-Holotypus; SP35357 - Isotypus.

Excipula schomburgkiae Hennings. Hedwigia 41: 308. 1902.

Host: on living leaves of *Schomburgkia* sp. (?); Brazil, São Paulo, Dec. 1901, Puttemans 407.

Herbaria: B-? (Hein, 1988); SP32748 – (?).

Observations: In the SP exsiccatum, Kuhlmann identified the host as *Stanhope graveolens.*

Gloeosporium aracearum Hennnings. Hedwigia 41: 308. 1902.

Hosts: on living leaves of *Caladium* sp; Brazil, São Paulo, Horto Botânico, Apr. 1900, Puttemans 82; on living leaves of *Philodendron bipinnatifidum*; Brazil, São Paulo, Horto Botânico, Dec. 1901, Puttemans 404.

Herbaria: B-Syntypus; SP32760 – Syntypus.

Gloeosporium ligustri Hennings. Hedwigia 41: 308. 1902.

Host: on living leaves of *Ligustrum vulgare*; Brazil, São Paulo, Horto Botânico, Dec. 1901, Puttemans 398.

Herbaria: B-Holotypus; SP32759 – Isotypus.

Observations: In the SP exsiccatum, the host is given as *Ligustrum* sp.

Helminthosporium brassicae Hennings. Hedwigia 41: 117. 1902.

Host: on leaves of *Brassica oleracea*; Brazil, São Paulo, Horto Botânico, 23 Apr. 1900, Puttemans 115.

Herbaria: B-Holotypus; SP32774 - Isotypus.

Helicoma bambusae Hennings. Hedwigia 41: 310. 1902.

Host: *Bambusa* sp. (*Baqueara lecca*); Brazil, São Paulo, Horto Botânico, Oct. 1901, Puttemans 350.

Herbaria: B-Holotypus; SP32719 - Isotypus.

Lasmenia machaerii Hennings. Hedwigia 41: 307. 1902.

Host: on living leaves of *Machaerium lanatum*; Brazil, São Paulo, Serra da Cantareira, Aug. 1901, Puttemans 335.

Herbaria: B-Holotypus; SP32753 - Isotypus.

Macrosporium puttemansii Hennings. Hedwigia 41: 118. 1902.

Host: on living leaves of *Pirus malus*; Brazil, São Paulo, Horto Botânico, 15 Apr. 1901, Puttemans 196.

Herbaria: B- ? (Hein, 1988); SP32722 – (?).

Observations: In the SP exsiccatum, the the collection number is given as 196.

Pestalozzia anthurii Hennings. Hedwigia 41: 116. 1902.

Host: on living leaves of *Anthurium brasiliense*; Brazil, São Paulo, Horto Botânico, July 1900, Puttemans 154.

Herbaria: B-Holotypus; SP32767 - Isotypus.

Pestalozzia ardisiae Hennings. Hedwigia 41: 116. 1902.

Host: on living leaves of *Ardisia grandis*; Brazil, São Paulo, Horto Botânico, 16 July 1901, Puttemans 287.

Herbaria: B-Holotypus; SP32768 - Isotypus.

Pestalozzia puttemansii Hennings. Hedwigia 41: 115. 1902.

Host: on living leaves of *Camellia japonica*; Brazil, São Paulo, Mandaqui, 23 Apr. 1900, Puttemans 147.

Herbaria: B- ? (Hein, 1988); SP32769 – (?).

Phyllosticta anonae Hennings. Hedwigia 41: 113. 1902.

(= *Phoma* sp., revised by Hein, 1988)

Host: on living leaves of *Anona* sp.; Brazil, São Paulo, Serra da Cantareira, 25 Apr. 1901, Rammar 212.

Herbaria: B-Typus ? (Hein, 1988); SP32684 – (?).

Phyllosticta bauhinicola Hennings, Hedwigia 41: 306. 1902.

Host: on living leaves of *Bauhinia* sp.; Brazil, São Paulo, Serra da Cantareira, Apr. 1901, Puttemans 189.

Herbaria: B-Holotypus; SP32678 - Isotypus.

Observations: In the SP exsiccatum, Kuhlmann identified the host plant as *Bauhinia forficata.*

Phyllosticta cydoniicola Hennings. Hedwigia 41: 114. 1902.

(=*Phoma macrostoma*, revised by Hein, 1988)

Host: on living leaves of *Cydonia vulgaris* ; Brazil, São Paulo, Horto Botânico, 04 June 1901, Puttemans 263.

Herbaria: B-Holotypus; SP32675 - Isotypus.

Phyllosticta dioscoreae-daemonae Hennings. Hedwigia 41: 305. 1902.

Host: on living leaves of *Dioscorea daemona*; Brazil, São Paulo, Horto Botânico, Apr. 1900, Puttemans 131.

Herbaria: B-Holotypus; SP32681 - Isotypus.

Observations: In the SP exsiccatum, Kuhlmann identified the host plant as *Dioscorea triphylla* var. *daemona*

Phyllosticta guarea Hennings. Hedwigia 41: 113. 1902.

(=*Phomopsis guarea*, revised by Hein, 1988)

Host: on living leaves of *Guarea trichiloides*; Brazil, São Paulo, Horto Botânico, 28 May 1901, Puttemans 248.

Herbaria: B-Holotypus; SP32677 - Isotypus.

Phyllosticta oroxylonis Hennings. Hedwigia 41: 306. 1902.

(=*Phoma* sp., revised by Hein, 1988)

Host: on living leaves of *Oroxylon indicum*; Brazil, São Paulo, Horto Botânico, Apr. 1900, Puttemans 119.

Herbaria: B-Holotypus; SP32679 - Isotypus.

Phyllosticta rubi Hennings. Hedwigia 41: 306. 1902.

Host: on living leaves of *Rubus* sp.; Brazil, São Paulo, Horto Botânico, June 1901, Puttemans 277.

Herbaria: B-Holotypus; SP32674 - Isotypus.

Phyllosticta sapindi Hennings. Hedwigia 41: 306. 1902.

Host: on living leaves of *Sapindus saponaria*; Brazil, São Paulo, Horto Botânico, Mar. 1900, Puttemans 60.

Herbaria: B-Holotypus; SP32680 - Isotypus.

Pseudobeltrania Hennings, Hedwigia 41: 310, 1902.

Type species: *P. cedrelae* Hennings

Host: on living leaves of *Cedrela fissilis* Vell.; Brazil, São Paulo, Horto Botânico, Apr. 1901, A. Puttemans 229,

Herbaria: B-? (Hein, 1988); SP32718 – Syntypus.

Tetracrium Hennings. Hedwigia 41: 116. 1902.

Type species: *T. aurantii* Hennings.

Host: on branches and leaves of *Citrus aurantium*; Brazil, São Paulo, Horto Botânico, 26 July 1901, Puttemans 282.

Herbaria: B-Holotypus; SP32775 - Isotypus.

ACKNOWLEDGMENT

The authors thank Dr. Marcelo P. Marcelli, Curator of the Herbarium (SP) of the "Instituto de Botânica" for the facilities and Dr. U. Braun, Martin-Luther-Universität, Institut für Geobotanik und Botanischer Garten, Halle, Germany, for the critical review of this paper.

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MYCOTAXON

Volume LXXVIII, pp. 499-502 April-June 2001

NEW COMBINATIONS OF CLADINA EPITHETS IN CLADONIA (ASCOMYCOTINA: CLADONIACEAE)

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ABSTRACT: On the basis of our molecular phylogenetic results we propose that specific and infraspecific epithets currently placed in the segregate genus *Cladina* be transferred to the genus *Cladonia*, and that *Cladina* become a synonym of *Cladonia*. Of the almost fifty species and infraspecific taxa currently recognized as accepted names, we have identified 14 epithets at specific or infraspecific ranks that require transfer into the genus *Cladonia*. Of these, eight have never been placed in the genus and six have not been recognized at their proposed rank or position in *Cladonia*. In addition, the author citation of the name *Cladina mitis* is corrected.

KEYWORDS: Lichen-forming fungi, Lecanoromycetes, Lecanorales, nomenclature

In the course of monographic studies in the lichen family Cladoniaceae, we have examined the phylogenetic relationship of *Cladonia* P.Browne and its segregate genus *Cladina* Nyl. This segregate was introduced in 1866 during a period marked by conflicting generic concepts and classification systems, and it was only one of 83 new genera described by Nylander (Hale 1984). As originally described, the genus included *Cladina rangiferina* (L.) Nyl., in addition to two highly-branched species currently recognized as members of *Cladonia* sect. *Unciales* (Delise) Oksner ex Ahti. Within a few years Leighton (1871) returned the species of *Cladina* to *Cladonia* as subg. *Cladina*, a nomenclature that was followed in Vainio's monographic treatment (Vainio 1887, 1894, 1897). Sandstede's critical "Cladoniae exsiccatae" (Sandstede 1918-1929) also recognized subg. *Cladina* within *Cladonia*. Des Abbayes (1939) and Ahti (1961) monographed the group as *Cladonia* subg. *Cladina*. During this period very few authors (e.g., Olivier 1908) continued to use *Cladina* at the rank of genus.

Hale & Culberson (1970) resurrected the genus *Cladina* in their checklist of North American lichens. Ahti, who had originally treated *Cladina* as a subgenus of *Cladonia* (Ahti 1961), later followed these authors by recognizing *Cladina* at the generic level (Ahti 1984, but see Ruoss & Ahti 1989). Subsequently, *Cladina* and *Cladonia* were recognized as separate genera in numerous publications; other authors continued to include *Cladina* within *Cladonia*. Most notably, Ahti (2000) recognized the genus *Cladina* in his comprehensive treatment of Neotropical Cladoniaceae.

Our molecular phylogenetic results (DePriest et al. 1999, 2000, and manuscript in prep.), based on maximum parsimony and maximum likelihood analyses of nucleotide sequences from multiple gene regions, support the hypothesis that *Cladina* as currently delimited is polyphyletic relative to *Cladonia*. Furthermore, a monophyletic group including representatives of the type species of *Cladina*, *C. rangiferina*, is a sister taxon to one including representatives of the type species of *Cladonia* sect. *Perviae* (Fr.) Mattick and sect. *Cocciferae* (Delise) A. Evans. Therefore, the two latter sections, as defined by their type species, are more closely related to the type species of *Cladina* than to that of *Cladonia*, *C. subulata* (L.) F.H. Wigg. If a monophyletic circumscription of *Cladonia* includes sections *Perviae* and *Cocciferae*, then *Cladina* must be included as well. This supports earlier phylogenetic results of Stenroos et al. (1997) using morphological characters. Also, Hammer (1997a, b) discussed morphological similarities between *Cladina* and species in sect. *Cocciferae*.

On the basis of these results (to be published elsewhere) we propose that *Cladina* be reduced to synonymy under *Cladonia*. To recognize all accepted species and infraspecific taxa of *Cladina* as members of *Cladonia* in our forthcoming synopsis of the family Cladoniaceae requires some nomenclatural combinations. Six specific and two infraspecific epithets were published after the resurrection of *Cladina* and, to our knowledge, have never been placed in *Cladonia* (see Ahti 1993, 2000). In addition, we recommend recognizing six epithets at new ranks or positions in *Cladonia*. The required combinations of these epithets that reflect our current understanding of this group are presented here. Also, the citation of the name *Cladina mitis* is corrected since the combination of Monguillon (1938) has priority over the usually-cited combination of Hustich (1951).

Cladonia arbuscula (Wallr.) Flot. subsp. ***boliviana*** (Ahti) Ahti & DePriest, comb. nov.;
basionym: *Cladonia boliviana* Ahti, Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo" 32(1): 131. 25 Sep 1961.
synonym: *Cladina boliviana* (Ahti) Ahti, Beih. Nova Hedwigia 79: 50. 1984.
synonym: *Cladina arbuscula* subsp. *boliviana* (Ahti) Ahti, Fl. Neotrop. Monogr. 78: 44. 3 Mar 2000.

Cladonia arbuscula (Wallr.) Flot. subsp. ***imshaugii*** (Ahti) Ahti & DePriest, comb. nov.;
basionym: *Cladonia imshaugii* Ahti, Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo" 32(1): 113. 25 Sep 1961.
synonym: *Cladina imshaugii* (Ahti) Ahti, Beih. Nova Hedwigia 79: 50. 1984.
synonym: *Cladina arbuscula* subsp. *imshaugii* (Ahti) Ahti, Fl. Neotrop. Monogr. 78: 49. 3 Mar 2000.

Cladonia arbuscula (Wallr.) Flot. subsp. ***pachyderma*** (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladina arbuscula* subsp. *pachyderma* Ahti, Fl. Neotrop. Monogr. 78: 50. 3 Mar 2000.

Cladonia argentea (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladina argentea* Ahti, Ann. Bot. Fenn. 23: 221. 26 Nov 1986.

Cladonia atrans (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladina atrans* Ahti, Fl. Neotrop. Monogr. 78: 69. 3 Mar 2000.

Cladonia ciliata Stirt. f. ***flavicans*** (Flörke) Ahti & DePriest, comb. nov.; basionym: *Cladonia rangiferina* f. *flavicans* Flörke De Cladon. 164. Pasq. 1828.

Cladonia confusa R. Sant. f. ***bicolor*** (Müll. Arg.) Ahti & DePriest, comb. nov.; basionym: *Cladonia rangiferina* f. *bicolor* Müll. Arg., Rev. Mycol. 1: 8. 1879.
synonym: *Cladina confusa* f. *bicolor* (Müll. Arg.) Ahti, Beih. Nova Hedwigia 79: 34. 1984.

Cladonia densissima (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladina densissima* Ahti, Beih. Nova Hedwigia 79: 38. 1984.

Cladonia densissima (Ahti) Ahti & DePriest f. ***decolorans*** (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladina densissima* f. *decolorans* Ahti, Beih. Nova Hedwigia 79: 40. 1984.

Cladonia halei (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladina halei* Ahti, Ann. Bot. Fenn. 23: 224. 26 Nov 1986.

Cladonia kalbii (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladina kalbii* Ahti, Fl. Neotrop. Monogr. 78: 53. 3 Mar 2000.

Cladonia kriegeri (Ahti & S. Stenroos) Ahti & DePriest, comb. nov.; basionym: *Cladina kriegeri* Ahti & S. Stenroos in Ahti, Fl. Neotrop. Monogr. 78: 55. 3 Mar 2000.
Cladonia mitis Sandst., Cladon. Exsicc. No. 55. 20 Mar 1918.
synonym: *Cladina mitis* (Sandst.) Mong., Bull. Soc. Agric. Sarthe, ser. 3, 7: 118. 1938.

Cladonia pycnoclada (Pers.) Nyl. f. ***fuscescens*** (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladonia pycnoclada* var. *fuscescens* Ahti, Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo" 32(1): 35. 25 Sep 1961.
synonym: *Cladina pycnoclada* f. *fuscescens* (Ahti) Ahti, Beih. Nova Hedwigia 79: 32. 1984.

Cladonia rangiferina (L.) F. H. Wigg. subsp. ***abbayesii*** (Ahti) Ahti & DePriest, comb. nov.; basionym: *Cladonia rangiferina* var. *abbayesii* Ahti, Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo" 32(1): 94. 25 Sep 1961.
synonym: *Cladina rangiferina* subsp. *abbayesii* (Ahti) W.L.Culb., in Vezda, Lich. Sel. Exsicc. 76: 3 [No. 1883]. Aug 1983.

ACKNOWLEDGMENTS

We thank Kati Kärkkäinen, Ilona Oksanen, Michele Piercey-Normore, Masoumeh Sikaroodi and Rebecca Yahr for their collaboration in the molecular phylogenetic analysis, Ellen Farr, Sarah K. Eichhorn, Soili Stenroos, and Samuel Hammer for their contributions to a synopsis of names in the Cladoniaceae, and Samuel Hammer, Harold

Robinson, and Harrie Sipman for their helpful review of this manuscript. This work was supported by a NSF-PEET grant (9712484) and Smithsonian Institution Scholarly Studies Award to P. T. D., and an Andrew W. Mellon Fellowship to T. A.

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MYCOTAXON
Volume LXXVIII, pp. 503-504 April-June 2001

ONLINE RESOURCES FOR FUNGAL TAXONOMY & NOMENCLATURE:
Nomenclatural Resources

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We have relied for a long time on the massive databases developed at the US National Fungus Collections. They were among the very first online resources in mycology, have consistently been of the highest quality, and still provide essential tools for mycologists.

U.S. National Fungus Collections databases	http://NT.ars-grin.gov/fungaldatabases/

FunIndex

The esteemed mycological group at CABI International (formerly IMI) have compiled a very impressive database of fungal names (variety through family). FunIndex and its related databases include information from the Index of Fungi, Petrak's Lists, the Saccardo Index, Saccardo's Omissions, Zahlbruckner's Catalogue of Lichens, Lamb's Index, the Dictionary of the Fungi classification, and an index to the abstracting journal Bibliography of Systematic Mycology. Whew! The Dictionary of Fungi classification is especially interesting, as it includes a preview of the system to be used in the forthcoming 9th edition.

FunIndex	http://www.speciesfungorum.org/

Nomenclatural Practice

The internationally accepted rules for naming fungi are detailed in the *International Code of Botanical Nomenclature*, the latest version of which has not appeared on the WWW as of this writing, except in Slovak translation. The official English version can be purchased from Koeltz Scientific Books. Dr. R. H. Petersen provides notes on changes of significance to mycologists as a bonus in his useful nomenclatural primer.

St. Louis Code (in Slovak)	http://nic.savba.sk/sav/inst/botu/SBS1/newkod/
Koeltz Scientific Books	http://www.koeltz.com/
Nomenclatural tutorial	http://fp.bio.utk.edu/mycology/Nomenclature/nom-intro.htm

The Phylocode, a radically alternative system of nomenclature, has appeared on the web in draft form. It is a rankless system that proposes to attach names to clades, and is worth a look. M.J. Benton's rebuttal is excerpted from *Biological Reviews* and is amusingly subtitled "is Linnaeus dead?"

The Phylocode	http://www.phylocode.org/
Stems, nodes, crown clades, and rank-free lists: is Linnaeus dead? by M.J. Benton	http://palaeo.gly.bris.ac.uk/phylocode/biolrev.html

And we mustn't forget the Biocode, a proposal that aims to apply a single set of rules to the naming of all organisms.

The Biocode	http://www.rom.on.ca/biodiversity/biocode/

Practical Nomenclature

The Smithsonian Institution provides a searchable index to names proposed for conservation or rejection in the journal *Taxon*. In mycology, the Committee for Fungi is responsible for discussing and proposing action on such proposals. Their discussions can be followed on their website.

Conserved plant names: proposals and disposals	http://persoon.si.edu/codes/props/
Committee for Fungi	http://www.cbs.knaw.nl/Research/Nomenclature.htm

Finding a taxonomist who specializes in an unfamiliar group of organisms can be challenging. The services below can be of help, but will only be useful if taxonomists (like you) submit information. The Index Herbariorum, recently grandly updated, will help you find herbaria. The International Plant Names Index is most useful as a source of standard abbreviations for author names, as it does not yet include fungal names.

World Taxonomist Database	http://www.eti.uva.nl/database/WTD.html
TRED	http://www.nbii.gov/datainfo/syscollect/tred/index.html
Index Herbariorum	http://www.nybg.org/bsci/ih/ih.html
IPNI	http://www.ipni.org/searches/query_author.shtml

Taxon-specific resources

As granting agencies increasingly demand generation of online resources, some labs are posting nomenclators to the internet. Please do let me know about yours.

Aphyllophorales (CBS)	http://www.cbs.knaw.nl/aphyllo/database.html
Cortbase (Corticiaceae s.l.)	http://www.systbot.gu.se/database/cortbase/cortbase.html
DERMBASE (Dermateaceae)	http://www.Bgbm.fu-berlin.de/BGBM/RESEARCH/DATA/dermatea/default.HTM
Freshwater ascomycetes & anamorphs	http://www.life.uiuc.edu/plantbio/fungi/
Fusarium (CBS)	http://www.cbs.knaw.nl/fusarium/database.html
Xylariaceae (new URL)	http://mycology.sinica.edu.tw/Xylariaceae/
Yeasts (CBS)	http://www2.cbs.knaw.nl/yeast/webc.asp

MYCOTAXON

Volume LXXVIII, pp. 505-513 'April-June 2001

BOOK REVIEWS AND NOTICES[1]

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GENERAL

Systematics in Mycology. By Larissa Vasilyeva. 1999. [Bibliotheca Mycologica Vol. 178.] J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, D-14129 Berlin, Germany. Pp. 253. ISBN 3 443 59080 2. Price: DM 120.

This book, whose first version was published in Russian in 1990, is a very informative and stimulating, albeit controversial, piece of work. It deals with almost all aspects of theoretical taxonomy as applied to mycology-at-large. The book is divided into four main parts: Evolutionary systematics, Phylogenetic systematics, Classificatory typology, and Numerical systematics. To give an idea of its structure and content, are the titles of the three chapters which make up Part II (Phylogenetic systematics): (1) Phylogenetic hypotheses (Previous attempts; Recent attempts), (2) Cladistic hypotheses (At species level; At genus level; Molecular studies), and (3) Cladistic ideas (Uncertain variation and directional evolution; Radiating patterns of evolution; Sister groups; Monophyly and paraphyly). Ideas developed by mycologists throughout the previous century are collected, and presented in a clear way. From this point of view the book is important as a source of historical information, the more so considering that it includes important developments published in Russian, and which remain almost unknown to western scientists. However, the author does not limit herself to the mere illustration of ideas and concepts: she tries to expose various attempts at the solution of controversial taxonomic problems, often presenting usual notions in a different light. The style is blunt and polemic, which contributes to rendering the book challenging and stimulating for the reader. As an example, here are some sentences from the Preface: 'Mycological books and papers are full of the same confusion, prejudices, and fruitless debates...Talk about the peculiarity of species concepts in mycology only betrays a conceptual confusion. Fungal features do not provide fundamentally different ideas...'. The spectrum of topics is so broad, their treatment is so dense, and many of the problems are so controversial, that it would be impossible to criticize here solutions the author proposes. It is certain that almost every reader could find something on which to disagree. However, the capacity to stimulate critical thinking is perhaps the most appealing feature of this book. Its reading is recommended, also outside the boundaries of mycology, and even of systematics: the book can be of interest to any educated biologist.

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[1] Books for consideration for inclusion in this column should be sent to the Book Review Editor at his permanent address and **not** to that in Madrid: David L. Hawksworth, MycoNova, 14 Finchley Lane, Hendon, London NW4 1 DG, UK; tel/fax [+44] (0) 20 8203 4282; e-mail myconova@btinternet.com. Unsigned reviews and notices are by the Book Review Editor.

The Fifth Kingdom on CD-ROM. By Bryce Kendrick. December 2000. Mycologue Publishers, 8727 Lochside Drive, Sidney-by-the-Sea, BC V8L 1M8, Canada. Version 2.2. Price: Can $ 80, US $ 55 (individual use); Can $ 200, US $ 135 (library or laboratory one-year licence; annual updates Can $ 100); Can $ 400, US $ 270 (class and lecture use; annual updates Can $ 200) [all prices include shipping].

This newly released CD-ROM is mentioned briefly here as it will be of value to all mycologists keen to share their enthusiasm for fungi with others. The emphasis is not primarily taxonomic, six of the 24 chapters covering the different fungal groups, and the remainder most aspects of mycology one could think of. The key feature is the over 1100 illustrations, mostly superb quality colour photographs – including many photomicrographs. This is of course combined with the authors enthusiastic personal style of prose which has been a hallmark of the previous printed editions of *The Fifth Kingdom.* The CD technology also means that hot-links to definitions of terms in the huge glossary exist to reduce the barriers in communication that jargon can create. If you are involved in teaching mycology, this is something that would really capture the imagination of your classes, and merits use even if you find that the taxonomic arrangement is not to your personal taste. Bryce informs me that the third hard copy edition of *The Fifth Kingdom* has just appeared (February 2001; CAN $ 60, US $ 40), but no copy had reached *Mycotaxon* by the time this column had to close; further information on that will be given in a future issue of *Mycotaxon.*

ASCOMYCETES

Morphotaxonomy and Chorology of the genus *Hypoxylon* (*Xylariaceae*) in Norway. By A[lfred] Granmo. September 1999. [Sommerfeltia No. 26.] Natural History Museums and Botanical Garden, University of Oslo, Sars gt. 1, N-0562 Oslo, Norway. Pp. 80, figs 57 (23 in colour). ISSN 0800-6865, ISBN 82 7420 037 3. Price: NKr 120.

Twelve species are recognized in Norway and documented in detail with respect to their description and illustration, and further their host ranges and distribution. Two species are newly described, *Hypoxylon porphyreum* and *H. salicicola*; both had previously been found but the collections reported as belonging to *H. rutilum* and *H. fuscum* respectively. It is intereresting to see clear host and geographical patterns emerging as our knowledge of the genus increases. There is an overall key to the accepted species. For each of those there are details on nomenclature and synonymy, full decriptions (including line drawings, colour habit photographs, and SEM pictures of ascospores), taxonomic notes, information on ecology and distribution (including a map), separation from other species, comments, and lists of specimens studied. The latter are sometimes rather excessive, for example 6.25 pages in small type are devoted to specimens of *H. multiforme* studied; most journals today would ask for a list of 'representative collections' to be cited and request the author to deposit the full list in some institution or society library – in this case they are presumably accessible in the author's PhD thesis ! I would have preferred to see descriptions and drawings of the anamorphs, an aspect summarily dismissed in ten lines in the introductory sections (apart from the description and illustrations of one of the new species, *H. porphyreum*).

Hypoxylon fragiforme is given the author citation '(Pers.: Fr.) J. Kickx f.' rather than '(Scop.: Fr.) J.Kicx f.' on the grounds that neither Persoon nor Fries referred directly to Scopoli's name (which Granmo nevertheless still includes as a definite synonym). This matter merits further scrutiny, especially because of the different versions of the pertinent Persoon work and recent changes made in Art. 33 of the *Code*. .

This is certainly the most important work on the genus in Europe to have appeared since the treatment by the Petrini's in 1986 (*Mycologia Helvetica* **1**: 501-627), and also benefits from being able to rest on the base of Jue & Rogers's world overview (*Mycologia Memoir* **20**: 1-365, 1996). The colour photographs are an added bonus, and perhaps the fullest set on the genus yet to appear in a single work. If you are struggling to identify *Hypoxylon*'s in northern Europe, this is surely the first work to go to.

The Genus *Nemania s. l.* (*Xylaricaeae*) in Norden. By A[lfred] Granmo, T[homas] Læssøe and T[rond] Schumacher. September 1999. [Sommerfeltia No. 27.] Natural History Museums and Botanical Garden, University of Oslo, Sars gt. 1, N-0562 Oslo, Norway. Pp. 96, figs 86. ISSN 0800-6865, ISBN 82 7420 038 1. Price: NKr 135.

This revision of *Nemania,* the former *Hypoxylon serpens* group, in the Nordic countries accepts 14 species in the genus, and also treats the segregates *Enteroleuca* and *Euepixylon* – each with one species in the region. The emphasis is a full and traditional critical morphological approach, with synonymies, descriptions, taxonomic notes, ecology, distribution maps, drawings of microscopic features, and photographs (many in colour). Anamorphs were successfully cultured from several species and these are also illustrated. In addition the ITS rDNA region of 12 taxa was studied and phylogenetic analyses of this makes clear that *Nemania* is monophyletic – but also had a major surprise. *Hypoxylon multiforme* and *Entoleuca mammata* came out with a 100 % bootstrap value. These genera were not synonymized however as 'this is at present not reconcilable with the results from conventional taxonomy'; the issue clearly needs to be revisited and the results of 'conventional taxonomy'questioned. It was also surprising to find species new to science in such a well-studied group in Europe: *N. prarva* is formerly described as new but was previously known as *H. atropurpureum* var. *brevistipitatum*), but two others not previously recognized were discovered but frustratingly left unnamed. Three species are also transferred into *Nemania* for the first time, *N. aureolutea, N. colliculosa,* and *N. reticulata.* The work on typification and nomenclature has been carefully examined, and some new typifications made of old names. In the case of *Sphaeria colliculosa,* a 'neotype' was proposed but this surely should be an 'epitype' as Schweinitz material is still extant – although in a poor condition (some also evidently representing different species). This work will be of lasting value to all endeavouring to identify *Nemania* collections in Europe, but it should be noted that four species known elsewhere in Europe were not found in the Nordic countries and so are absent from the keys.

Ausūniečiai (*Pezizales*). By Ernastas Kurtoga. 2000. Institutum Botanicae Lithuaniae, Universitas Vilnensis; UAB 'Valstiečių Laikrašis, Laisvés pr. 60, 2056 Vilnius, Lithuania. [Lietuvos Grybai (Mycota Lithuaniae) Vol. 3 (5).] Pp. 276, figs 56, coloured plates 16. ISBN 9986 847 36 2. Price: Not indicated.

This installment of the treatment of the Lithuanian mycobiota covers members of the *Pezizales* (including *Tuberales*). The work is unusual for this type of floristic series, in that it is primarily based on around 1250 collections made by the author over the years 1987-99, rather than mainly on past records. The first section of the book provides an overview of the characters (with many line drawings) and changing classification of pezizalean fungi, including results from molecular phylogenetic studies, and appears to provide a first-rate introduction to the order. The number of species accepted in this order as occurring in Lithuania is 158; these belong to 52 genera in nine families. Full nomenclatural information with places of publication is given on each, together with full references to pertinent literature and published illustrations, detailed descriptions, distribution, ecology and keys. Line drawings and scanning electron micrographs of ascospores are provided, and the colour plates mostly show the habits of the species. The keys also include 47 species not so far recorded from the country but which might be expected to be present – a most useful idea. Information on the frequency and times of fruiting are included, eight being listed in the Red Data Book for Lithuania and a further 13 proposed for incorporation. One taxonomic change is suggested, the transfer of *Septularia semiimersa* to a new genus *Sepultariella,* but the generic name is deliberately not validly published here and stated to be 'provisional'. As the series is primarily for use in the country the text is naturally and rightly in Lithuanian. However, an extended summary and English translation of the lucid keys is provided which renders the book of value to a much wider audience; an English translation of the introductory sections would also have been most welcome ! This carefully and critically prepared text is somethingis all specialists in *Pezizales* should consider adding to their shelves. Dr Kurtoga is to be congraulated on this achievement, and I look forward to the appearance of further parts under his name.

LICHEN-FORMING FUNGI

The Foliicolous Lichens of Japan. By Göran Thor, Robert Lücking and Tatsuo Matsumoto. 2000. [Symbolae Botanicae Upsalienses Vol. 32(3)] Distributed by Almqvist & Wiksell International, Stockholm. Pp. 72, figs 7 (3 in colour). ISSN 0082-0644, ISBN 91 554 4661 2. Price: Not indicated.

While the lichens living on leaves in the Americas and Africa have been the subject of considerable attention in the last two decades, those of Asia have been relatively neglected. This report is remarkable in that in a lichenologically relatively intensely studied country like Japan, studies based on two years fieldwork have yielded 83 such lichens, a staggering 11 (13 %) being described as new to science, and 52 further species (63 %) new records for Japan. I.e. the known diversity of the lichens in this particular habitat in Japan (including the southern Japanese islands) has been increased by 76 %. Most of the newly described species belong to well-known pantropical genera. It is also notworthy that this result has been achieved by team-work between specialists from Europe (with experience in other tropical areas) and a Japanese lichenologist with special knowledge of promising localities; this model clearly has much to commend it. I was also pleased to see that the primary material was lodged in Japanese herbaria (HIRO and TNS) with some duplicates being lodged elsewhere (mainly UPS) – again an example of a practice to be emulated.

But this work is not just of interest from the standpoint of documenting the mycobiota of Japan. It will be of value to all working on foliicolous lichens for the single key to the treated species, and for the colour plates which show the macroscopic features of 20 different taxa. This is the largest assemblage of colour photographs of these fungi yet to have appeared in one publication.

The species are arranged alphabetically, and under each information is given on their systematic position, distribution, distinguishing features, observations, and details the specimens examined. Numerous references are included, but sadly not the places of publication or even dates of the species themselves.

It is now clear that Asia will prove to be a major source of yet more novel foliicolous lichens, and this work now provides a tool that can be used as a starting point by those keen to explore the diversity and ecology of these fungi in the region further.

Corticolous Macrolichens of Low Montane Rainforests and Moist Woodlands of Eastern Tanzania. By H[ildur] Krog. July 2000. [Sommerfeltia No. 28.] Natural History Museums and Botanical Garden, University of Oslo, Sars gt. 1, N-0562 Oslo, Norway. Pp. 75, figs 5. ISSN 0800-6865, ISBN 82 7420 041 1. Price: NKr 135.

The contribution to our knowledge of east African macrolichens made over the last 25 years by Hildur Krog and the late 'Dougal' Swinscow can only be described as outstanding. Their co-operation culminated in *Macrolichens of East Africa* (British Museum (Natural tHistory), London, 1988), a work renowned for its photographs, lucid keys, and descriptions. The geographical coverage of that work meant that it could not include detailed information on particular habitats or countries. In the case of these particular forest types in Tanzania, this is now rectified by the present work which is mainly based on subsequent collecting vists made in 1988 and 1989.

In all, 224 macrolichen species were collected on trees in the West Usambara, Nguru, Uzungwa, and Poroto Mountains, and the Rungwe volcano, three of which are described as new to science (*Hypotrachyna olivetorica, Parmotrema iringense,* and *Ramalina dissimilis*). Following treatments of the new species, the remainder are listed alphabetically, with information on their chemical components as determined by thin-layer chromatography and details of the collections made; almost all are deposited in Oslo (including the holotypes of the new species) and while recognizing the problems of long-term security for collections in Tanzania from my own experience, if some duplicates at least could be lodged for instance in the University of Dar es Salaam they would have been a boon to any aspiring new lichenologist in the region. No descriptions (except for the new species) or keys are provided, these being already available in the 1988 book. Also note that scale bars are lacking on Figs 3-5 due to a mistake during the printing; these should measure 17.8 mm on Figs 3 and 5, and 16.5 mm on Fig. 4.

I must admit to being somewhat surprised to see 'that, for practical reasons, all recent splits within the genus *Parmelia s. lat.* have been adopted' (p. 10), and that only chemical differences were the basis of two of the three newly described species. I was saddened that Hildur seems to have bowed under peer pressure to alter the more justifiable approach adopted to parmelioid lichens in the 1988 book – especially at a time when molecular data are starting to show that only more conservative generic concepts can be justified. Hildur was a true pioneer of our understanding of chemical variation in parmelioid lichens from her classic paper of 1951 using microcrystal tests (*Nytt Magazin for Naturvidenskapene* **88**: 57-85, 1951), and many so-called chemical species actually do have small and constant differences in anatomical or morphological characters when studied in detail. I remember demonstrating to Hildur in the field in the UK back in 1971 that *Parmelia discordans* and *P. omphalodes* could be distinguished with a hand lens and not only by chemical tests; such correlating features should always be searched for when describing new parmelioid species.

Of especial importance for conservation and our knowledge of macrolichen ecology and biogeography, are the few pages devoted to 'Distribution' (pp. 14-17). Eleven species appear to be endemic to the region. Attention is also drawn to comparisons with the Mascarene Islands, currently being studied, which have some six species confined to these two areas. I would have liked to have seen these sections of the work expanded because the enormous amount of personal knowledge Hildur has on these aspects has still to be distilled onto paper for future generations. Perhaps this remarkable women can be encouraged to devote some time to that on her flights to and from Mauritius and Réunion ?

Taxonomía del Género *Peltigera* Willd. (Ascomycetes Liquenizados) en la Península Ibérica y Estudio de sus Hongos liquenícolas. By María Isabel Martínez Moreno. April 1999. [Ruizia Vol. 15.] Real Jardín Botánico, Plaza de Murillo 2, E-28014 Madrid, Spain. Pp. 200, figs 37. ISBN 84 00 07803 9, ISSN 0212-9108. Price: Not indicated.

A thorough revision of the genus and its lichenicolous fungi in Andorra, Portugal and Spain based on some 4000 collections and particularly extensive field studies – the map indicating sites visited is amazing. Twenty-three species of *Peltigera* are accepted, four species and one variety being reported from the area for the first time. In addition, two new undscribed morphotypes and a new chemotype are reported. For each species there are full bibliographic citations with key synonyms, details of types, a full description with anatomical details, chemical constituents, full discussions of relationships and separations, lists of specimens studied, and distribution maps. There are numerous thallus sections, some as scanning electron micrographs, and unusually for studies on macrolichens information on, for example, the heights of thallus layers with means and standard deviations. No habit photographs are included.

Particular attention was given to the lichens and lichenicolous fungi growing on *Peltigera* thalli. Eleven lichens were found and 30 lichenicolous fungi – 24 being new records for the Peninsula and including some rarely collected species (e.g. *Graphium apthosae, Lasiosphaeriopsis salisburyi, Pronectria ornamentata*). That so many lichenicolous fungi could be found in one study testifies again to the richness of the genus for other fungi.

A key is provided to the *Peltigera* species treated, but sadly not to the lichens and lichenicolous fungi. This key will be of considerable value to all struggling to identify members of this difficult genus in Europe and it is to be hoped that the author will be able to execute comparable studies on other lichens in the region in the future..

Katalog der Flechten und flechtenbewohnenden Pilze Deutschlands. By Peter Scholz. December 2000. [Schriftenreihe für Vegetationskunde No. 31.] Bundesamt für Naturschutz, Schriftenvertrieb im Landwirstchaftsverlag GmbH, 48084 Münster, Germany. Pp. 298. ISBN 3 7843 3501 2. Price: DM 29.80.

The first critical catalogue of lichens known from the whole of Germany to have appeared since V. J. Grummann's *Catalogus Lichenum Germaniae* (Springer Verlag, Berlin, 1963), notwithstanding the checklist 'Arbeitshilfe' prepared by V. Wirth in 1994 (*Stuttgarter Beitrage für Naturkunde, Biologie* **517**: 1-63) which also covered lichenicolus fungi. The layout of the new checklist is strictly alphabetical by genus. The systematic position and key literature on each genus is given, followed by lists of the accepted species. For each species information is provided on the provinces in which the species occur, published maps, key literature, and references to published illustrations. The references to illustrations in other works will be of particular value also to lichenologists in other countries searching for photographs and figures of the habit or microscopic features of particular species. Other species referred to the genus which are not now placed there are cross-referenced at the end in the style of R. Santesson's *The Lichens and Lichenicolous Fungi of Sweden and Norway* (1993) which clearly served as a model. A staggering 2325 species are accepted, of which 219 are lichenicolous fungi. The dates and places of publication of the taxa are not given in the body of the text, but they are in a long list of species not previously reported from the country - where those have been published as quite a few are marked as `in Vorb.' Two new combinations are made: *Carbonea distans* var. *buelliarum* (syn. *Lecidea distans* var. *buelliarum*) and *Neofuscelia pulla* var. *pokornyi* (syn. *Imbricaria pokornyi*). The bibliography is enormous, extending over 22 pages. This carefully compiled checklist will now be the standard reference point for our knowledge of German lichens and lichenicolous fungi, and the author is to be congratulated not only on compiling so much information, but presenting it in such a clear style.

Lichens: an illustrated guide to the British and Irish species. By Frank S. Dobson. 4th edn. December 2000. Richmond Publishing, P. O. Box 963, Slough SL2 3RS, UK. Pp. 431, figs, coloured photographs, maps. ISBN 0 85546 093 8 (hardback), 0 85546 094 6 (paperback). Price: £ 45 (hardback), £ 30 (paperback).

The last edition of this now standard introduction to British and Irish lichens appeared in 1992. This edition covers about 700 species, 100 more than in the third edition, meaning that almost half the species known in the two countries are now treated. But this is not the most noticeable change. In this edition, instead of the species descriptions being accompanied by half-tones, almost all now have colour photographs. In addition, the etymology of generic names has been added, and illustrations of ascus tip reactions in iodine inserted in some cases. As before, the miniaturized distribution maps are taken from data currently in the British Lichen Society's mapping scheme. The introductory sections have swelled to include information on lichen photobionts.

The approach is very much hands-on, and the keys have been developed in the light of the author's extensive experience of running adult field courses on lichens each year for over 20 years. As many of the species are widely distributed in temperate regions, the book will be of value to all teaching lichen identification. However, as the genera are treated alphabetically, I missed a synopsis showing the orders and families to which the genera belong, and felt that the bibliography could have been expanded beyond a single page – aspects to consider for the fifth edition. The colour photographs and increase in the number of species treated mean that this new edition should have an ever wider appeal than its predecessors, and I would expect most lichenologists to secure a copy for their libraries.

BASIDIOMYCETES

Flora Agaricina Neerlandica. Vol. 4. Edited by C. Bas, Th. W. Kuyper, M. E. Noordeloos and E. C. Vellinga. 192 pp. 1999. A. A. Balkema, P. O. Box 1675, 3000 BR Rotterdam, Netherlands. ISBN 90 5410 492 9 (hardbound), ISBN 90 5410 493 7 (paperback). Price: Not indicated.

The latest volume of this major work closely follows the format of its predecessors. The General Part is slightly expanded but largely repeated from Vol. 3, the Taxonomic Part covers *Strophariaceae* and two tribes of *Tricholomataceae*: *Tricholomateae* and *Xeruleae*. There is a new generic index covering Vols. 1-4. Any summary verdict must endorse Scott Redhead reviewing Vol. 3 (*Mycotaxon* 57: 487, 1996) 'The contributors are maintaining standards toward which we all should aspire... It is a scholarly publication in the finest tradition'. Not only scholarly, it is also a practical identification handbook; the keys are clearly designed for use rather than for the display of phylogeny.

Strophariaceae are here defined in a narrow sense (as foreshadowed by Bas in Vol. 1 Chapter 5) excluding both *Panaeolus* and *Phaemarasmius*. They are treated by Noodeloos in just two genera: *Pholiota* (seven subgenera including *Hemipholiota* and *Kuehneromyces*) and *Psilocybe* (six subgenera including *Stropharia*, *Hypholoma* and *Melanotus*). It can be asked whether enough new taxonomic insights have been gained to justify all this nomenclatural upheaval. Alternatively is this a logical stopping point on the road to Kühner's suggested single genus for all *Strophariaceae*? *Tricholomateae* here covers *Tricholoma*, *Porpoloma*, *Tricholomopsis* and *Melanoleuca*. *Xeruleae* covers *Baeospora*, *Hydropus*, *Megacollybia*, *Mycenella*, *Oudemansiella*, *Strobilurus* and *Xerula*. This leaves three tribes of the *Tricholomataceae* still to come: *Lyophylleae*, *Cystodermateae* and the bulk of *Myceneae*. Regrettably there are no plans to include cyphelloid genera.

Some minor corrections: On p. 29 *Pholiota nematolomoides* is consistently misspelt '*nematoloides*'. Hiding in the synonymy of *Pholiota oedipus* (Cooke 1885) P. D. Orton on p. 102 is *Agaricus dissimulans* Berk. & Broome 1882, an earlier name perhaps better treated as doubtful; the type at Kew was examined and considered a distinct species by Singer and Orton. On p. 135 it should be made clear that the icon on Phillips' p. 37 cited for *Tricholoma argyraceum* is the one Phillips calls *T. inocybeoides*; it is not the *T. argyraceum* on that same page (which gets cited for *T. scalpturatum*). The spores of several *Psilocybe* species (e.g. *P. rugosoannulata* on p. 61) appear to be shown at around x 2000 rather than the stated figure of x 1500 for all spores. The index has some duplicate entries and even three for *Agaricus squamosus*.

There must be concern at the pace of this project. After nearly twenty years only four of a projected ten volumes have appeared. Delays are taking their toll. The account of *Melanoleuca* was clearly prepared long ago; it cites no icons later than Phillips' of 1981, ignoring the *Fungi of Switzerland* Vol. 3 of 1991 (if nothing else the *M. humilis* of that work should be cited for *M. turrita*). The remaining six volumes need a production schedule of one every two years to minimse the risk that they never come out at all. The trouble is presumably funding. In a well-ordered world a project of such international importance undertaken by one small country would be a prime candidate for supranational backing. Meanwhile any library covering agaric taxonomy should invest in the series so far.

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North American Boletes. A Color Guide to the Fleshy Pored Mushrooms. By A.E. Bessette, W.C. Roody and A.R. Bessette. 2000. Syracuse University Press, Syracuse, NY. Pp. 396. ISBN 0 8156 0588 9. Price: Not indicated.

This book is a welcome resource for the identification of North American boletes for both professional and amateur mycologists. Most of the bolete taxa have been richly illustrated with colour photographs, of which all but a dozen were taken in the field. Variable species have been illustrated with multiple photographs that show the range of variation. The photographs are of a high quality, though the natural background is sometimes distracting or so similar in colour to part of the basidiome that it is challenging to see the fungus (e.g. *Boletus rainisii*, *B. zelleri*, *Tylopilus sordidus, T. ammiratii*). Especially welcome are photographs of 27 morphospecies that are yet to be described as this should stimulate further collecting. Descriptions are provided for 308 named species and varieties of boletes and 18 other poroid basidiomycetes that could be confused with boletes. The descriptions are concise and presented in a way that facilitates finding the main characters. The comments are informative, providing common synonyms, characteristics used to distinguish similar taxa, and unusual ecolological relationships (e.g. the dependency of *Gyrodon meruliodes* on aphids which feed on the roots of *Fraxinus*). Also noted are the status of unresolved species complexes (e.g. the *Boletus edulis* complex), and disagreements over generic limits (e.g. in *Pulveroboletus*). Descriptions and photographs are organized alphabetically by genus and species, making them easy to locate. The introductory material, glossaries, and keys that are based solely on macroscopic characteristics will facilitate use by amateurs. Species are divided among keys by the colour of the tube mouths when young, the presence or absence of an annulus and the type of stipe ornamentation; separate keys are provided for the eastern and western regions. Each species in the keys is accompanied by a brief description and a reference to the page number of the full text. Because microscopic characters have been excluded, many of the keys end in a choice of five to seven species belonging to several genera. Species having variable colours, ornamentation, or staining reactions, and those occurring in both eastern and western North America are found in several places within or among keys, increasing the probability of finding the species in question among the choices. The keys were tested on ten bolete collections from the Dominican Republic that represented both eastern and western North American species from six genera. Both the eastern and western keys worked well. The undescribed species, however, were not included in the keys and references to these were also absent from the comments under similar or related species.

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Fungi of Switzerland. Vol. 5 Agarics. Part 3 *Cortinariaceae*. By J. Breitenbach and F. Kranlin, 2000. Edition Mykologia, P. O. Box 165, CH-Lucerne 9, Switzerland. ISBN 3-85604-250-4 (English); -150-9 (French); -050-1 (German). Price CHF 158.

Part 5, which has been anticipated with excitement, lives up to the standard set by the earlier volumes and like them is of wider application than the title suggests. The format remains the same with generally superb colour photographs of the taxon under consideration faced by a description of macro- and micro-characters, ecology and nomenclatoral comments and accompanied by line-drawings of the important micro-features. The material used in each illustration is cited so that future changes in concept can be easily tracked down. The main text is preceded by a short introduction including preface, acknowledgements, synposis of methods, specialised literature, glossary of terms ,and a key. The last will be of limited value as it only deals with the species considered and there are many more species in the *Cortinariaceae* even in Switzerland which do not get even a mention. That would be a herculean task anyway, but the volume is a good snap shot. Indices of authors and scientific names are also given. 411 species are dealt with in this Part, and a further 24 accepted varieties, mans a coverage of 435 taxa.

This Part covers some of the most difficult agaric genera - *Inocybe* and *Cortinarius*, two very large and important ectomycorrhizal groupings in temperate and boreal areas. In addition, the very closely related genus *Rozites* (1 species) and the white-spored *Leucocortinarius bulbiger* are considered, accompanied the putative root parasites placed in the *Phaeocollybia* (5 species) and the wood and litter rotters in *Gymnopilus* (10 species) and related saprotrophic agarics in *Galerina* (which may have closer relationships to their accompanying bryophytes than considered previously), and species often confused with the small species of *Cortinarius* placed in the subgenus *Telamonia* complete the rust-coloured spored group.

However, the volume starts with the often highly toxic genus *Inocybe*, constituents of which sport dull brown spores; 46 % of the species considered exhibit a nodulose spore-outline. *Hebeloma* (30 species) only 50 years ago would have been represented by a handful of taxa, and it is good to see so many of the distinctive species now recognised, illustrated. Other smaller genera considered include *Crepidotus* (8 species), *Simocybe* (4 species), and *Phaeogalera* (2 species).

As is now traditional, *Cortinarius* is split into seven subgenera: *viz Myxacium* (17 species), *Phlemacium* (58 species), *Sericeocybe* (22 species) a subgenus with which some authors dismiss; *Dermocybe* (13 species), *Leprocybe* (15 species), *Cortinarius* (1 species) and finally the hygrophanous group placed in *Telamonia* (87 species). *Dermocybe* and *Phlegmacium* have been accepted by some authors as independent genera but molecular studies are now challenging this and the traditional subdivision of the larger *Cortinarius*. In both *Cortinarius* and *Inocybe* species are illustrated for the first time in colour, or certainly never since their original description, especially some of the montane taxa. Indeed for all the workers in arctic/alpine agarics this is a most useful source book.

This volume is a fitting tribute to Breitenbach, for it is saddens the reviewer to report that during the preparation of Part 5 he passed away. This volume, however, has lost none of the earlier character and commitment of which he was an intimate part. It is an important addition of any mycological bookshelf, just as are it predecessors. This is a welcome and necessary publication which will directly help European mycologists come to grips with brown spored agarics, but indirectly define for extra-European workers the concepts currently adopted for some for the evasive classical names.

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Guide to the Literature for the Identification of British Basidiomycetes. By Bert Brand, Alick Henrici and Patrick Leonard. February 2001. British Mycological Society, Joseph Banks Building, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, UK. Pp. 51. ISBN 0 9527704 5 8. Price £ 5.

Although with a British focus, this new literature guide will be of value to a wide range of students of larger basidiomycetes in particular as a quick way of locating particular papers and books, including those to accounts of individual genera in serial works such as *Flora Agaricina Neerlandica, Fungi of Switzerland,* and *Flore Mycologique d'Europe* as well as the *British Fungus Flora.* It differs from the last literature guide, produced by the Society in 1982, not only in focussing on larger basidiomycetes (although there are a few references to works on rusts and smuts) but in deliberately recommending particular works – something which is necessarily subjective but helpful to a beginner starting to find his or her way around the daunting array of mycologial literature.

Bolets de Catalunya. XIX Col-Lecció. Edited by the Societat Catalana de Micologia. 2000. Societat Catalana de Micologia, Càtedra de Botànica, Facultat de Farmacia, Av. Diagonal 643, 08028 Barcelona, Spain. Laminated plates 50. ISSN 0212-3460. Price: Not indicated.

This installment of the series covers 50 species, taking the total so far treated to 950. Each laminated sheet has a superb colour photograph on one side, and text on the reverse. The text provides a formal description, including microscopic features, notes any often used or recent synonyms, and has brief information on ecology and edibility. A wide range of macromycetes (including larger ascomycetes and even slime moulds) are being covered in the series. This number includes species belonging to the following genera: *Agrocybe, Amanita, Callistosporium, Collybia, Cordyceps* (as '*Cordiceps*), *Cortinarius, Craterellus, Creopus, Cystolepiota, Encoelia, Entoloma, Gastrosporium, Gerronema, Hapalopilus, Hohenbuehelia, Hygrophorus, Hymenoscyphus, Inocybe, Inonotus, Lactarius, Leucopaxillus* (as '*Leocopaxillus*'), *Lepiota,* *Lyophyllum, Marasmiellus, Melanoleuca, Mycena, Onnia, Peziza, Phaeomarasmius, Physarum, Rhodocybe, Russula, Stcitis,* and *Xeroconus.* The cards are prepared by different members of the Catalan Mycological Society, and the key feature is the quality of the photographs. While the incorrect spellings of generic names are unfortunate, a welcome feature not seen in many colour guides is the detailed citation of the collection details of the specimens photographed together with information of where voucher specimens have been deposited. As the series grows, it becomes an increasingly important source of reference illustrations as well as a resource for those trying to name macromycetes from Catalonia.

MISCELLANEOUS

Raffaele Ciferri: Scienziato versatile e critico. Edited by Guiseppe Caretta and Augusto Pirola. November 2000. [Fonti e Studi per la storia dell'Università di Pavia No. 34.] Cisalpino, Istituto Editoriale Universitario – Monduzzi Editore S.p.A, Via B. Eustachi, 12-20129 Milano, Italy. Pp. X + 186, figs (including 24 coloured plates). ISBN 88-323-4591 9. Price: Ll 60 000 [Special internet price Ll 55 000].

It is often helpful to know more of the background of particular mycologists when endeavouring to understand their approaches to the science. The italian mycologist Raffaele Ciferri (1897-1964) was exceptional in the range of his mycological interests, and just how much of a polymath he was is reflected in this tribute to him, based on a symposium in his memory held at the University of Pavia in December 1997. In addition to biographical information, the articles included cover Ciferri's contributions to plant pathology, taxonomy, bibliography, lichen nomenclature, medical mycology, phytosociology, plant physiology, and botanic gardens. Texts and copies of poster presentations, many in colour, follow the main chapters. Many have copies of drawings and other material from Ciferri's works, and also cover perhaps less systematic interests – notably collecting coins. Although in Italian, apart from one chapter in English, by perusing the topics and illustrations it is possible to obtain a glimpse of a leading mycologist energetically and enthusiastically persuing numerous aspects of pure and applied mycology. I never met Ciferri, but to those fluent in Italian I am sure the six personal testimonials also included would add depth to that glimpse. The volume certainly led me to an increased respect for Ciferri, and I am sure mycologists working on the taxonomy of groups he studied would similarily enjoy dipping into this work.

Biology of Dermatophytes and other Keratinophilic Fungi. Edited by Rajendra K. S. Kushwaha and Josep Guarro. 2000. Revista Iberoamericana de Micología, Departamento de Immunología, Microbiología y Parasitología, Facultad de Medicina y Odontología, Universidad del Pais Vasco, Apdo. 699, E-48080 Bilbao, Spain. Pp. 177. ISBN 84 607 0711 3. Price: Eur 100.

This book is mentioned here because it will be of interest to systematic mycologsists as it includes overviews of the taxonomy of dermatophytes (M. F. Simpaya), molecular systematics (Y. Gräser, G. S. de Hoog & A. F. A. Kuijpers), the molecular phylogeny of *Chrysosporium* (P. Vidal, M. A. Venuesa, J. M. Sánchez-Puelles & J. Guarro), and reflections of the evolution of form and function (R. C. Summerbell). I was personally pleased to see Dr Simpayana's use of dates of publication after author citations even where the actual publications were not being quoted, as this is something I always find helpful and try to encourage. The study on *Chrysosporium* is of especial interest in showing the fungi referred to it to be polyphyletic and belonging to different orders; they suggest that the genus is restricted to anamorphs of *Onygenales, Geomyces* to those of *Myxotrichaceae,* and *Myceliophthora* to those of *Sordariales,* and also identify some new cases of synonymy. These four systematic papers are among 21 contributions which cover both medical and ecological aspects of these fungi, and because of this the work will be of interest to those working in these disparate fields but on the same groups of fungi – and the first place to turn to for overviews of current knowledge in cognate aspects of these two disciplines. The book is timely with the current revival of interest in soil mycology, and it is also very well produced and illustrated, with many photographs in colour, and the Argentinian, Brazilian, and Spanish mycological societies which sponsor the *Revista* are to be congratulated on this venture.

NOMENCLATURAL NOVELTIES PROPOSED IN MYCOTAXON VOLUME 78

Acrodictyella obovata W. A. Baker & Partridge, p. 31
Acrodictyella W. A. Baker & Partridge, p. 30
Amanita exitialis Zhu L.Yang & T. H. Li, p. 439
Antrodiella tuberculata Ryvarden & Guzmán, p. 246
Castanaedaea minor (R. F. Castañeda) W. A. Baker & Partridge, p. 178
Castanedaea W. A. Baker & Partridge, p. 176
Chaetochalara proteae Joa. E. Taylor, Crous, & M. E. Palm, p. 451
Cladonia arbuscula (Wallr.) Flot. subsp. *boliviana* (Ahti) Ahti & DePriest, p. 500
Cladonia arbuscula (Wallr.) Flot. subsp. *imshaugii* (Ahti) Ahti & DePriest, p. 500
Cladonia arbuscula (Wallr.) Flot. subsp. *pachyderma* (Ahti) Ahti & DePriest, p. 501
Cladonia argentea (Ahti) Ahti & DePriest, p. 501
Cladonia atrans (Ahti) Ahti & DePriest, p. 501
Cladonia ciliata Stirt. f. *flavicans* (Flörke) Ahti & DePriest, p. 501
Cladonia confusa R. Sant. f. *bicolor* (Müll.Arg.) Ahti & DePriest, p. 501
Cladonia densissima (Ahti) Ahti & DePriest f. *decolorans* (Ahti) Ahti & DePriest, p. 501
Cladonia densissima (Ahti) Ahti & DePriest, p. 501
Cladonia halei (Ahti) Ahti & DePriest, p. 501
Cladonia kalbii (Ahti) Ahti & DePriest, p. 501
Cladonia kriegeri (Ahti & S. Stenroos) Ahti & DePriest, p. 501
Cladonia pycnoclada (Pers.) Nyl. f. *fuscescens* (Ahti) Ahti & DePriest, p. 501
Cladonia rangiferina (L.) F. H. Wigg. subsp. *abbayesii* (Ahti) Ahti & DePriest, p. 502
Conidiosporomyces echinospermus (Ainsw.) Vánky, p. 314
Coniothyrium septatum Joa. E. Taylor, p. 79
Dictyosporium triramosum Aramb., Cabello, & Cazao, p. 185
Didymosphaerella yuccae A. W. Ramaley & M. E. Barr, p. 435
Eleutheromyces longispora N. Maekawa & Tsuneda, p. 168
Elsinoë fecunda Joa. E. Taylor & Crous, p. 84
Heteroconium neriifoliae Joa. E. Taylor, Crous, & M. E. Palm, p. 453
Hypocrella tenuispora P. G. Liu & Z. Q. Li, p. 71
Macalpinomyces aristidae-cyananthae (Bref.) Vánky, p. 303
Macalpinomyces chrysopogonicola (Mundk. & Thirum.) Vánky, p. 320
Menegazzia chrysogaster Bjerke & Elvebakk, p. 371
Menegazzia kawesqarica Bjerke & Elvebakk, p. 376
Microsphaeropsis diffissa Bianchin., p. 60
Mycosphaerella holualoana Crous, Joa. E. Taylor, & M. E. Palm, p. 458
Mycosphaerella konae Crous, Joa. E. Taylor, & M. E. Palm, p. 459
Mycosphaerella leucospermi Crous & Joa. E. Taylor, p. 87
Mycosphaerella shoreae Crous & U. Braun, p. 339
Mycosphaerella waimeana Crous, Joa. E. Taylor, & M. E. Palm, p. 463
Passalora ambrosiae (Chupp) Crous & U. Braun, p. 321
Passalora fagarina (Chupp) Crous & U. Braun, p. 332
Passalora lettsomiae (Thirum. & Chupp) Crous & U. Braun, p. 334
Passalora panacis (Thirum. & Chupp) Crous & U. Braun, p. 336
Passalora querci (Chupp) Crous & U. Braun, p. 337
Pezicula magnispora Z. H. Zhong & Zheng Wang, p. 161
Pholiota bambusina K. A. Thomas & Manim., p. 181
Physalospora hawaiiensis Joa. E. Taylor, Crous, & M. E. Palm, p. 471

Phytophthora oryzo-bladis J. S. Wang & J. Y. Lu ex H. H. Ho, p. 20
Placodiplodia hilata Bianchin., p. 63
Pseudocercospora pistaciae (Chupp) Crous & U. Braun, p. 338
Pseudocercospora zanthoxylicola Crous & U. Braun, p. 334
Pseudodoassansia hydrocleydis Vánky, p. 274
Puccinia austroyunnanica J. Y. Zhuang & S. X. Wei, p. 345
Setchelliogaster tenuipes (Setch.) Pouzar var. *rheophyllus* (Bertault & Malençon) G. Moreno & M. P Martín, p. 262
Sporisorium aristidae (S. Ahmad) Vánky, p. 304
Sporisorium aristidae-lanuginosae (Maire) Vánky, p. 304
Sporisorium aristidicola (Speg.) Vánky, p. 305
Sporisorium coelorachidis Vánky, p. 292
Sporisorium confusum (H. S. Jacks.) Vánky, p. 306
Sporisorium fraserianum (Syd.) Vánky, p. 308
Sporisorium goniosporum (Massee) Vánky, p. 308
Sporisorium horsfallii Vánky, p. 297
Sporisorium panici (E. Mackinnon) Vánky, p. 295
Sporisorium polytocae (Mundk.) Vánky, p. 286
Sporisorium polytocae-barbatae (Mundk.) Vánky, p. 286
Sporisorium polytocae-digitatae Vánky, p. 287
Sporopodium aeruginascens Lücking & Lumbsch, p.23
Stegolerium kukenani Strobel, W. M. Hess, & E. J. Ford, p. 356
Stegolerium Strobel, W. M. Hess, & E. J. Ford, p. 356
Stenella salicis (Chupp & H. C. Greene) Crous & U. Braun, p. 342
Stenella shoreae (Thirum. & Chupp) Crous & U. Braun, p. 339
Stenella solidaginis (Chupp & H. C. Greene) Crous & U. Braun, p. 342
Stictis leucospermi Joa. E. Taylor, Crous, & M. E. Palm, p. 474
Stigmina californiae Joa. E. Taylor & Crous, p. 91
Tilletia cynodontis Vánky, p. 294
Tilletia palpera J. Walker & Vánky, p. 309
Tilletia punensis (S. D. Patil & Gandhe) Vánky, p. 290
Tilletia setariae-viridis Vánky, p. 316
Trametes mexicanus Ryvarden & Guzmán, p. 251
Trametes subviride Ryvarden & Guzmán, p. 252
Tylopilus pakaraimensis T. W. Henkel, p. 106
Tyromyces mexicanus Ryvarden & Guzmán, p. 251
Tyromyces subviride Ryvarden & Guzmán, p. 252
Urocystis alstroemeriae Vánky & C.Vánky, p. 267
Urocystis thaxteri Vánky, p. 270
Uromyces hainanicus J. Y. Zhuang & S. X. Wei, p. 349
Ustilago acroceratis Vánky, p. 293
Ustilago latzii Vánky, p. 282
Ustilago triraphidis Vánky, p. 282
Ustilentyloma oreochloae (Durrieu) Vánky, p. 319

Author Index, Volume Seventy-Eight

Ahti, Teuvo, & Paula T. DePriest. New combinations of *Cladina* epithets in *Cladonia* (Ascomycotina: Cladoniaceae), 78: 499-502, 2001.

Arambarri, A. M., M. N. Cabello, & M. C. Cazau. *Dictyosporium triramosum,* a new Hyphomycete from Argentina, 78: 185-189, 2001.

Baird, Gary, see Strobel & al.

Baker, William A., E. Christopher Partridge, & Gareth Morgan-Jones. Notes on Hyphomycetes. LXXXI. *Acrodictyella obovata,* a new lignicolous, dematiaceous genus and species collected in Alabama, 78: 29-35, 2001.

Baker, William A., see Partridge & al.

Baseia, Iuri Goulart, see Gusmão & Baseia

Bianchinotti, María Virginia. New species of Coelomycetes from Argentina, 78: 59-66, 2001.

Bjerke, Jarle W., & Arve Alvebakk. The sorediate species of the genus *Menegazzia* (Parmeliaceae, lichenized Ascomycotina) in southermost South America, 78: 363-392, 2001.

Bougher, N. L., see Lago & al.

Braun, Uwe, see Crous & Braun

Cabello, M. N., see Arambarri & al.

Castro, M. L., see Lago & al.

Cazau, M. C., see Arambarri & al.

Corrado, M., see Moraes & al.

Costa, G. L., see Moraes & al.

Crous, Pedro W., & Uwe Braun. A reassessment of the *Cercospora* species described by C. Chupp: specimens deposited at BPI, Maryland, U. S. A., 78: 327-343, 2001.

Crous, Pedro W., see Taylor & al.

DePriest, Paula T., see Ahti & DePriest

Elvebakk, Arve, see Bjerke & Elvebakk

Ford, Eugene, see Strobel & al.

Gusmão, Luís Fernando Pascholati, & Iuri Goulart Baseia. A list of type specimens of microfungi described by P. Hennings held at the herbarium of Instituto de Botânica (SP), 78: 491-497, 2001.

Guzmán, Gastón, Miguel Angel Morón & Florencia Ramírez-Guillén. Entomogenous *Cordyceps* and related genera from Mexico with discussion on their hosts and new records, 78: 15-125, 2001.

Guzmán, Gastón. see Ryvarden & Guzmán

Hawksworth, David L. Book reviews and notices, 78: 505-513, 2001.

Henkel, Terry W. *Tylopilus pakaraimensis* sp. nov., a new bolete in *Tylopilus* section *Potamogetones* from Guyana, 78: 105-114, 2001.

Hess, W. M. see Strobel & al.

Ho, H. H. *Phytophthora oryzo-bladis,* a new species name for *P. fragariae* var. *oryzo-bladis,* 78: 17-21, 2001.

Hodge, Kathie T. Online resources for fungal taxonomy and nomenclature: nomenclatural resources, 78: 503-504, 2001.

Holanda, V. L., see Moraes & al.

Iturriaga, Teresa, see Ryvarden & Iturriaga

Lago, M., N. L. Bougher, & M. L. Castro. Morphological variability and implications for definition of taxa in the *Descolea-Setchelliogaster-Descomyces* complex, 78: 37-57, 2001.

Li, J. Y., see Strobel & al.

Li, Tai-Hui, see Yang & Li

Li, Zu-Qiang, see Liu & al.

Liu, Pei-Gui, Xiang-Hua Wang, Zu-Qiang Li, Zhu-Liang Yang, & Da-Cheng Zhang. Notes on the bambusicolous species of the genus *Hypocrella* from southwestern China, 78: 67-74, 2001.

Lourenço-de-Oliveira, R. de, see Moraes & al.

Lücking, Robert, & H. Thorsten Lumbsch. New species or interesting records of foliicolous lichens. VI. *Sporopodium aeruginascens* (Lecanorales), with notes on the chemistry of *Sporopodium,* 78: 23-27, 2001.

Lumbsch, H. Thorsten, see Lücking & Lumbsch

Lumbsch, H. Thorsten, see Schmitt &

Maekawa, Nitaro, & Akihiko Tsuneda. *Eleutheromyces longispora* sp. nov., with a *Hyphozyma* synanamorph isolated from a decaying basidioma of *Trametes versicolor,* 78: 167-173, 2001.

Manimohan, P., see Thomas & Manimohan

Martín, María P. Chorologic database of European *Rhizopogon* species, 78: 191-244, 2001.

Martín, María P., & Gabriel Moreno. Molecular data confirm *Setchelliogaster tenuipes* and *S. rheophyllus* as Cortinariales, 78: 257-263, 2001.

Mitchell, David W., see Stephenson & al.

Moraes, A. M. L., M. Corrado, V. L. Holanda, G. L. Costa, M. Ziccardi, R. de Lourenço-de-Oliveira, & P. C. Oliveira. *Aspergillus* from Brazilian mosquitoes - I. Genera *Aedes* and *Culex* from Rio de Janiero State, 78: 413-422, 2001.

Moreno, Gabriel, see Martín & Moreno

Morgan-Jones, Gareth, see Baker & al.

Morgan-Jones, Gareth, see Partridge & al.

Morón, Miguel Angel, see Guzmán & al.

Novozhilov, Yuri K., see Stephenson & al.

Oliveira, P. C., see Moraes & al.

Palm. Mary E., see Taylor & al.

Partridge, E. Christopher, see Baker & al.

Partridge, E. Christopher, William A. Baker, & Gareth Morgan-Jones. Notes on Hyphomycetes. LXXXII. A further contribution toward a monograph of the genus *Haplotrichum,* 78: 127-160, 2001.

Partridge, E. Christopher, William A. Baker, & Gareth Morgan-Jones. Notes on Hyphomycetes. LXXXIII. *Castanedaea,* a new genus in which to accommodate *Alysidium minus*, 78: 175-180, 2001.

Pfister, Donald H., see Zhong & al.

Ramaley, Annette W. *Didymosphaerella yuccae* sp. nov., 78: 435-438, 2001.

Ramírez-Guillén, Florencia, see Guzmán & al.

Ryvarden, Leif, & Gastón Guzmán. Studies in neotropical polypores 12. New and noteworthy polypores from Mexico, 78: 245-256, 2001.

Ryvarden, Leif, & Teresa Iturriaga. Studies in neotropical polypores 9. A critical checklist of poroid fungi from Venezuela, 78: 393-405, 2001.

Schmitt, Imke, & H. Thorsten Lumbsch. Identification of the photobionts in *Trapeliopsis* and *Pertusaria* using SSU ribosomal DNA sequences obtained from PCR amplification with a non-green-algal primer, 78: 407-411, 2001.

Schnittler, Martin, see Stephenson & al.

Sidhu, Rajinder S., see Strobel & al.

Stephenson, Steven L., Martin Schnittler, David W. Mitchell, & Yuri K. Novozhilov. Myxomycetes of the Great Smoky Mountains National Park, 78: 1-15, 2001.

Strobel, Gary, W. M. Hess, Gary Baird, Eugene Ford, J. Y. Li, & Rajinder S. Sidhu. *Stegolerium kukenani* gen. et sp. nov. an endophytic, taxol producing fungus from the Roraima and Kukenan tepuis of Venezuela, 78: 353-361, 2001.

Swart, Lizeth, see Taylor & al.

Taylor, Joanne E., Pedro W. Crous, & Lizeth Swart. Foliicolous and caulicolous fungi associated with Proteaceae cultivated in California, 78: 75-103, 2001.

Taylor, Joanne E., Pedro W. Crous, & Mary E. Palm. Foliar and stem fungal pathogens of Proteaceae in Hawaii, 78: 449-490, 2001.

Thomas, K. Agretious, & P. Manimohan. A new species of *Pholiota* from India, 78: 181-184, 2001.

Tsuneda, Akihiko, see Maekawa & Tsuneda

Vánky, Kálmán. Taxonomical studies in Ustilaginales. XXI, 78: 265-326, 2001.

Wang, Xiang-Hua, see Liu & al.

Wang, Zheng, see Zhong & al.

Wei, Shu-Xia, see Zhuang & Wei

Wolf, Jan H. D., see Guzmán & al.

Yang, Zhu-Liang, & Tai-Hui Li. Notes on three white *Amanitae* of section *Phalloideae* (Amanitaceae) from China, 78: 439-448, 2001.

Yang, Zhu-Liang, see Liu & al.

Yurchenko, Eugene O., & Ivan V. Zmitrovich. Variability of *Hyphoderma setigerum* (Corticiaceae s. l., Basidiomycetes) in Belarus and northwest Russia, 78: 423-434, 2001.

Zhang, Da-Cheng, see Liu & al.

Zhong, Zhihong, Zheng Wang, & Donald H. Pfister. *Pezicula magnispora,* a new species on an herbaceous plant, 78: 161-165, 2001.

Zhuang, Jian-Yun, & Shu-Xia Wei. P*uccinia austroyunnanica* sp. nov. on Gouania, 78: 345-347, 2001.

Zhuang, Jian-Yun, & Shu-Xia Wei. Some noteworthy tropical species of *Uromyces* from Hainan Island, 78: 349-351, 2001.

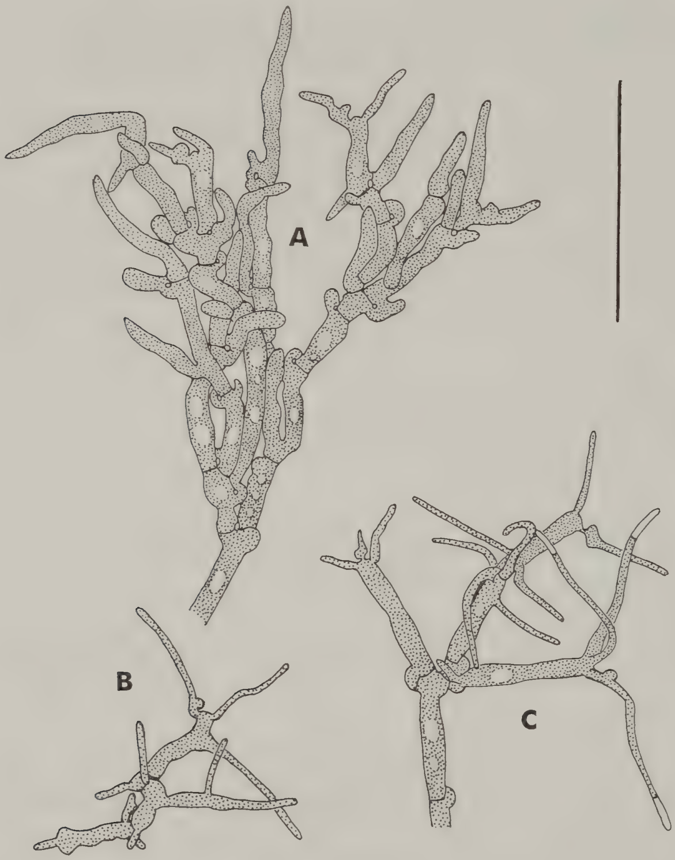
Ziccardi, M., see Moraes & al.

Zmitrovich, Ivan V., see Yurchenko & Zmitrovich

ERRATA

VOLUME SEVENTY-FIVE

Page 417 replace line drawings for Fig. 4 with these



VOLUME SEVENTY-EIGHT

p. 52, line 8	for *fragile*	read *fragilis*
p. 150, line 15	for *aureofulva*	read *aureo-fulva*
p. 249, line 3	for *subviridis*	read *subviride*
p. 397, line 33	for *angulatoporia*	read *angulatopora*
p. 397, line 34	for *duracinus*	read *duracina*
p. 415, line 14	for *sydowi*	read *sydowii*
p. 449, line 4	for *telopea*	read *telopeae*
p. 477, line 25	for *Pestalotipsis*	read *Pestalotiopsis*
p. 481, line 19	for *banksias*	read *banksiae*

INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME SEVENTY-EIGHT

This index includes names of genera, infrageneric taxa, species, and infraspecific taxa, as well as new names of suprageneric taxa. All new names are in CAPITALS. The page number on which a new name is proposed is followed by an asterisk (*).

Abundisporus 397
  fuscopurpureus 397
Acladium 127
  simile 151
ACRODICTYELLA 29-30*, 34-35
  OBOVATA 29, 31*-34
Acrodictys 29-30, 32, 34-35
  bambusicola 29, 34
  brevicornuta 34
  brooksiae 34
  deightonii 34
  martinii 34
  obliqua 34
  queenslandica 34
Albatrellus 248
Allescheriella
  crocea 151, 154
Alnicola
  melinoides 258, 261
Alternaria 96, 477
Alysidium 127, 160, 175
  aureofulvum 151
  guttulatum 175
  minus 175-176, 178-179
  pinarense 175
  resinae 175, 179-180
   var. microsporum 179
   var. resinae 179
Amanita 439, 447
 Subg. Lepidella 442
 Sect. Phalloideae 439, 442
  bisporigera 442
  EXITIALIS 439*-443
  oberwinklerana 439, 443-444
  phalloides 447
   var. striatula 442-443
  subjunquillea 447
   var. alba 439, 443-445, 447
  vaginata 446-447
  verna 439, 446-447
  virosa 439, 444, 446-447
Amauroderma 395
  auriscalpium 395
  boleticeus 395
  calcigenum 395
camerarium 395
  dubiopansum 395
  exile 395
  gusmanianum 395
  macrosporum 395
  omphalodes 395
  partitum 395
  praetervisum 395
  schomburgkii 395
  sprucei 395
  trichodermatum 395
Amorphotheca
  resinae 180
Amylosporus 397
  campbellii 397
Annellophora 32
Anomoporia
  bombycina 403
Anthostomella
  spartii 96
Antrodia 397
  albida 397
  gossypina 397
Antrodiella 245, 247, 397
  angulatopora 247, 397
  duracina 247, 397
  fissiliformis 403
  hydrophila 248, 397
  incrustans 247, 397
  liebmannii 248, 397
  murrillii 247
  reflexa 247
  semisupina 245-247, 249, 397
  subundata 397
  TUBERCULATA 245, 246*-247, 249
  versicutis 247, 398
Arcangiella 54
Arcyria
  cinerea 9
  denudata 9
  ferruginea 9
  globosa 12
  incarnata 9
  insignis 9
  obvelata 9

[Arcyria] pomiformis 9
  stipata 9
Armillaria
  mellea 479
  tabescens 96
Aschersonia 67, 116
  flavo-citrina 493
  viridans 122
  viridula 122
Ascochyta 479
  alstoniae 492
  basellae 492
  coffeae 492
Aspergillus 413-416, 421
  alutaceus 419
  aureolatus 414-415
  curtisii 134
  fischeri 417
  fischerianus 413, 415-417, 421
  flavus 413-417, 421
  fumigatus 416-417
  heteromorphus 413, 415, 417, 421
  kanagawaensis 416, 418
  laneus 134
  nidulans 413-414, 418
  nidulleus 415
  niger 413-416, 418, 421
  ochraceo-petaliformis 418
  ochraceus 415-416, 418, 421
  parasiticus 416, 419
  pulvinus 415-416, 419, 421
  sclerotiorum 415-416, 419
  sulphureus 416, 419
  sydowii 415, 420
  tamarii 415-416, 420-421
  terreus 415-416, 420
  versicolor 415, 420
Aureobasidium 479
Aurificaria 396
  luteoumbrina 396
Auriscalpium 248

Badhamia
  curtisii 6
  macrocarpa 12
  nitens 5
  papaveracea 5
  rugulosa 5
Badhamiopsis
  ainoae 5
Bahusakala 356, 360
Balansia 70
  bambusae 68, 70
Barbeyella
  minutissima 3
Batcheloromyces 93-94
  leucospermi 75, 93-94, 96
Bionectria
  ochroleuca 479
Bipolaris 481
Bjerkandera 398
  adusta 398
  fumosa 398
Boletus
  calopus 260-261
  lupinus 260-261
Bondarzewia 248
  berkeleyi 248
  montana 248
Botryobasidium 127-128, 158, 176
  chilense 132
  curtisii 134, 136
  lembosporum 156
  robustior 148
  simile 151
Botryodiplodia 96
Botryosphaeria 96, 478
  dothidea 75, 93-94, 96, 449, 479
  proteae 75, 94, 96, 449, 477-479
  quercuum 96
  ribis 480
Botryotinia
  fuckeliana 97, 480
Botrytis 480
  cinerea 97, 480
Brefeldia
  maxima 12
Brodoa 364
Bryoria 377

Calomyxa
  metallica 9
Calonectria
  colhounii 477, 480
Calonema
  aureum 12
Camarosporium 75, 77, 79, 97
CASTANEDAEA 175-176*, 179
  MINOR 177, 178*-179
Cavernularia 364
Ceratiomyxa
  fruticulosa 3
    var. porioides 3
Cercospora 327, 329-331
  achyranthina 328
  ambrosiae 331

[Cercospora] apii 328-331
  asclepiadis 493
  bangalorensis 337
  broussonetiae 337
  cajani 493
  cordylines 493
  cytisi 328
  exochordae 328
  fagarae 327, 332, 334
  fagarina 332
  filicum 493
  jamaicensis 338
  leguminum 338
  lettsomiae 334
  lithospermi 329
  madisonensis 329
  mysorensis 338
  nasturtii
    var. stanleyae 330
  panacis 336
  paramignyae 338
  partheniphila 329
  peregrina 329
  petila 330
  petiveriae 330
  pistaciae 338
  pouzolziae 338
  puttemasii 493
  querci 337
  richardsoniae 493
  salicis 342
  secalis 330
  shoreae 339
  solidaginis 342
  stanleyae 330
  stevensonii 331
  tertia 331
  urostigmatis 493
  waltheriae 339
  wisconsinensis 331
  wrightiae 339
Cercostigmina 94
  protearum 93
Ceriporia 398
  alachuana 398
  microspora 398
  purpurea 398
  spissa 398
  tarda 398
  xylostromatoides 398
Cerporiopsis 398
  umbrinescens 398
Chaetochalara 451-453
  aspera 453
  cladii 453
  PROTEAE 449, 451*-452, 478, 480
  ramosa 453
Chalara 451-452
Cintractia
  distichlidis 266, 321
  melinis 279
Cladina 206, 499-500
  arbuscula
    ssp. boliviana 500
    ssp. imshaugii 500
    ssp. pachyderma 501
  boliviana 500
  confusa
    f. bicolor 501
  densissima 501
    f. decolorans 501
  halei 501
  imshaugii 500
  kalbii 501
  kriegeri 501
  mitis 499-501
  pycnoclada
    f. fuscescens 501
  rangiferina 499-500
    ssp. abbayesii 501
Cladonia 216, 499-500
 Subg. Cladina 499-500
 Sect. Cocciferae 500
 Sect. Perviae 500
 Sect. Unciales 499
  arbuscula
    ssp. BOLIVIANA 500*
    ssp. IMSHAUGII 500*
    ssp. PACHYDERMA 501*
  ARGENTEA 501*
  ATRANS 501*
  boliviana 500
  ciliata
    f. FLAVICANS 501*
  confusa
    f. BICOLOR 501*
  cornuta 194
  DENSISSIMA 501*
    f. DECOLORANS 501*
  HALEI 501*
  imshaugii 500
  KALBII 501*
  KRIEGERI 501*
  mitis 501
  pycnoclada
    var. fuscescens 501

[Cladonia pycnoclada] f. FUSCESCENS 501*
  rangiferina
    ssp. ABBAYESII 501*
    var. abbayesii 501
    f. bicolor 501
    f. flavicans 501
  subulata 500
Cladosporium 97, 176, 480
  minus 176, 178
  resinae 179
Clastoderma
  debaryanum 3
  pachypus 3
Clavicorona 248
Climacocystis
  borealis 403
Clonostachys
  rosea 479
Coleroa
  senniana 75, 97, 449, 477-478, 480
Collaria
  arcyrionema 10
  lurida 10
  oculatum 10
Colletotrichum 474
  gloeosporioides 98, 449, 482
Coltricia 396
  hamata 396
  pyrophila 393, 396
Comatricha
  aequalis 10
  ellae 10
  laxa 11
  nigra 11
  pulchella 11
  reticulospora 11
  suksdorfii 11
  tenerrima 11
Conidiosporomyces 313, 318
  ayresii 313-315, 318
  ECHINOSPERMUS 265, 314*, 318
  verruculosus 313-315, 318
Coniothyrium 80, 97
  leucospermi 75, 97
  nitidae 81, 480
  protearum 483
  SEPTATUM 75, 79*-81, 97
Conocybe 257
Cordycepioideus 116
  octosporus 122
Cordyceps 115-116, 118-119, 121-122
  barnesii 119
  dipterigena 115, 117-118, 120, 122
  entomorrhiza 115, 117-118, 122
  gracilis 115, 117-118, 120, 122
  melolonthae 119
    var. melolonthae 119
    var. rickii 115-117, 119-120, 122
  militaris 115-117, 120, 122
  polyarthra 122
  pruinosa 115, 119-120, 123
  rickii 119, 121
  sobolifera 116, 123
  sphecocephala 123
  stylophora 123
Coriolopsis 398
  byrsina 398
  floccosa 398
  fulvocinerea 398
  polyzona 398
  rigida 398
Corticum 98
  latitans 432
  myxosporum 432
Cortinarius 54, 260
  armillatus 260-261
  caerulescens 258, 261
  traganus 260, 261
  trivialis 258, 261
Craterium
  minutum 6
  obovatum 6
Cribraria
  argillacea 4
  atrofusca 4
  cancellata 4
  confusa 4
  elegans 4
  ferruginosa 4
  intricata 4
  languescens 4
  macrocarpa 4
  microcarpa 4
  purpurea 4
  rufa 4
  splendens 4
  tenella 4
  violacea 4
Cryptosporiopsis 163
Cucurbitaria 79
Cyclomyces 396
  iodinus 396
  tabacinus 396
Cylindrocarpon 480
Cylindrocladium 477, 481

Daedalea 398
  aethalodes 398
  microsticta 398
  quercina 398
  stereoides 398
Daldinia
  concentrica 425
Datronia 398
  brunneo-leuca 398
  caperata 398
  scutellata 398
  stereoides 398
Denticularia
  tertia 331
Dermocybe 260
  sanguinea 260-261
  semisanguinea 260-261
  subcinnabarina 260-261
Descolea 37-39, 45, 48-49, 53-55
  alienata 45
  gunnii 37, 48, 53
  maculata 37-38, 45-48, 53-54
  rheophylla 41, 261-262
Descomyces 37-39, 49, 53-55
  albidus 261
  albus 38, 258
Diachea 6
  bulbillosa 6
  leucopodia 6
  splendens 6
  subsessilis 6
  verrucospora 6
Diacheopsis
  insessa 11
Dianema
  corticatum 9
  harveyi 9
Dichomitus 398
  cavernulosus 398
  setulosa 398
  squalens 403
Dictydiaethalium
  plumbeum 4
Dictyosporium 185
  alatum 185
  australiense 185-186
  brahmaswaroopii 185
  bulbosum 185
  campaniforme 185
  cocophilum 185
  crustaceum 185
  digitatum 185
  elegans 185
  foliicola 185
  gauntii 185
  giganticum 185
  heptasporum 185
  micronesicum 185-187
  nigroapice 185
  oblongum 185
  polystichum 185
  salami-sharma 185
  schizostachyfolium 185
  subramanianii 185
  tetraseriale 185
  toruloides 185
  TRIRAMOSUM 185*-187
  triseriale 185
  zeylanicum 185
Diderma
  corrugatum 6
  deplanatum 6
  effusum 6
  hemisphaericum 6
  ochraceum 6
  radiatum 12
  roanense 6
  rugosum 6
  testaceum 6
  umbilicatum 12
Didymium
  bahiense 6
  clavus 6
  crustaceum 6
  iridis 6
  melanospermum 6
  minus 6
  nigripes 6
  ovoideum 7
  sqamulosum 7
Didymosphaerella 435-436, 438
  longipes 438
  opulenta 438
  YUCCAE 435*-438
Didymosphaeria 84, 435-436
  futilis 75, 82, 84, 98
Diplodia 98
  camelliae 494
  juccae 64
Diplomitoporus 398
  crustulinus 403
  incisus 398
Doassansia
  Subg. Pseudodoassansia 274
Dothideodiplodia 64
Dothiorella 478, 481

Drechslera 481
  dermatoidea 449, 481

Earliella 398
  scabrosa 398
Echinochaete 398
  brachyporus 398
Echinopora 398
  aculeifera 398
Echinostelium
  apitectum 3
  arboreum 4
  bisporum 4
  minutum 4
Elaeomyxa
  miyazakiensis 7-8, 12
Elaphomyces 207
Eleutheromyces 168
  LONGISPORA 167, 168*-173
  mycophila 168, 171
  subulatus 168, 171, 173
Ellisembia 34
Elsinoë 86, 95, 481
  banksiae 449, 478, 481
  FECUNDA 75, 84*, 86, 98
  leucospermi 75, 86, 95, 98, 449, 481
Emericella
  nidulans
    var. nidulans 418
Endosporisorium
  capillipedii 320
Enerthenema
  papillatum 11
Enteridium
  lycoperdon 4
Entyloma 276, 295, 320
  farisii 279, 281
  oreochloae 266, 319
  speciosum 295
Epicoccum
  microscopicum 494
  pandani 494
Excipula
  schomburgkiae 494

Flaviporus 399
  brownii 399
Fomes 399
  fasciatus 399
Fomitopsis
  nivosa 245, 248
Fomitella 399
  supina 399
Fomitopsis 399
  cupreo-roseus 399
  durescens 399
  feei 399
  meliae 399
  nivosa 399
  palustris 399
Fuligo
  leviderma 7, 12
  septica 7
    var. rufa 12
Fusarium 98
Fuscocerrena 399
  portoricensis 399
Fusicladiella 82
Fusicoccum 94, 98, 449, 477-478, 482
  aesculi 94, 96, 479
  proteae 96, 98, 479

Ganoderma 395
  australe 395
  brownii 98
  colossus 395
  longistipitatum 395
  multicornis 395
  oerstedtii 395
  orbiforme 396
  resinaceum 396
  stipitatum 396
  zonatum 98
Gastrosuillus 54
Gautieria
  graveolens 214, 217
  pallida 208
Geoglossum 163
Gloeophyllum 399
  striatum 399
  trabeum 399
Gloeoporus 399
  dichrous 399
  thelephoroides 399
Gloeosporium
  aracearum 494
  ligustri 494
Glomerella 474
  cingulata 98, 482
Grammothele 395
  fuligo 395
  lineata 395
  subargentea 395
Graphium 482
Guignardia 467, 469, 471, 482
Gymnoglossum 48

[Gymnoglossum] gunnii 48

Haddowia 396
  longipes 396
Hapalopilus 399
  phlebiaeformis 399
Haplotrichum 127-128, 130, 148, 154, 158, 160, 175-176, 179
  Sect. Avesiculata 138
  Sect. Biformia 152
  Sect. Catenulata 130
  Sect. Haplotrichum 130, 132, 142
  Sect. Vesiculata 136, 138, 140, 144, 148, 150, 156, 158
  Subsect. Multidenticulata 132, 148
  Subsect. Paucidenticulata 130, 132, 142
  Subsect. Ramosa 136, 138, 140, 144, 148, 150, 158
  Subsect. Simplicia 156
  album 127, 129-131
  aureum 138
  capitatum 132, 134, 142, 148, 175
  chilense 127, 130, 132-134, 142, 157
  conspersum 138
  curtisii 127, 132, 134-137, 144, 150-151
  dubium 130, 142
  elongatum 138
  gracile 127, 137-140
  linderi 127, 132, 136, 138, 141
  magnisporum 158
  ochraceum 127, 130, 132, 134, 140, 142-143, 157
  ovalisporium 127, 142, 144-145
  parmastii 158
  perseae 158
  pulchrum 158
  ramosissimum 127, 134, 138, 140, 146-148, 150
  rubiginosum 127-128, 134, 136, 138, 148-151, 157
  simile 127-128, 136, 150-154, 156
  sphaerosporum 158
  tenerum 158
  tomentosum 127, 136, 154-157
  vesiculosum 127, 134, 138, 140, 157-159
Helicoma
  bambusae 494
Helminthosporium
  brassicae 494
Hemitrichia
  abietina 12
  calyculata 9
  clavata 9
  serpula 9
  stipitata 9
Hericium 248
Heterobasidion 248
Heteroconium 455
  citharexyli 455
  NERIIFOLIAE 449, 453*, 455, 478, 483
Hexagonia 399
  capillacea 399
  glabra 399
  hirta 399
  hydnoides 399
  leprosa 399
  papyracea 399
Hirsutella 116
  saussurei 123
  stylophora 123
  thompsonii 123
Hormoconis
  resinae 179-180
Hormodendron
  resinae 179
Humphreya 396
  coffeatum 396
  neurosporum 396
Hydnangium 54
Hydnum
  cristulatum 432
Hymenangium
  virens 209, 213, 220, 229-230
Hymenochaete
  tomentosa 154
Hymenogaster
  lycoperdineus 214
  pumilionum 219
Hymenostilbe 116
  dipterigena 118, 122
Hyperrhiza
  tuberiformis 226
Hyphoderma
  setigerum 423-424, 426-432
  spiculosum 432
Hyphogymnia
  physodes 425
Hyphozyma 167-168, 171-172
Hypochnus
  sub-zygodesmoides 134
Hypocrea
  bambusae 68
Hypocrella 67-68
  bambusae 67-68, 73-74
  discoidea 71
  TENUISPORA 67, 71*, 73-74

Hypogymnia 364, 379, 386
Hysterangium
  clathroides 229
  coriaceum 236
Hysteromyces
  vulgaris 213

Inonotus 396
  radiatus 403
  splitbergeri 396
  venezuelicus 396
Isaria 116
  cicadae 123
  cosmopsaltria 116, 123
  crinita 123
  dubia 122
  farinosa 123
  sinclairii 116, 123
Ischnoderma
  resinosum 403
Ityorhoptrum 29-30, 32
  verruculosum 32

Junghuhnia 399
  carneola 399
  collabens 403
  neotropica 399
  nitida 399
  polycystdifera 399
  semisupiniformis 399
  subundata 245, 250

Kabatiella 98, 483
Kalmusia 436
Kneiffia
  setigera 432

Laccaria 54
Lactarius 54
Laetiporus 399
  percicinus 399
  sulphureus 399
Lamproderma
  arcyrioides 12
  arcyrionema 10
  columbinum 11
  granulosum 1, 11-12, 14
  scintillans 11
Lasiodiplodia
  theobromae 478, 483
Lasmenia
  machaerii 495
Lembosia 483
Lentinellus 248
Lentinula
  edodes 168
Lenzites 399
  acuta 400
Leocarpus
  fragilis 7
Lepidoderma
  tigrinum 7
Lepiota
  cristata 446
Leptosphaeria 79
  lonicera 99
  protearum 94, 449, 477-478, 483
Licea
  belmontiana 4
  biforis 4
  castanea 4
  denudescens 4
  kleistobolus 5
  microscopica 1, 5, 12
  minima 5
  operculata 5
  parasitica 5
  pedicellata 5
  perexigua 5
  pusilla 5
  pseudoconica 5
  rufocuprea 1, 5, 12
  sambucina 1, 5, 12
  scyphoides 5
Lophiostoma 457
  fuckelii 99, 478, 483
Lophiotrema 457-458
Lycogala
  epidendrum 5
  exiguum 5

Macalpinomyces 266, 320
  ARISTIDAE-CYANANTHAE 266, 303*, 312
  chrysopogonis 320
  CHRYSOPOGONICOLA 266, 320*
Macbrideola
  cornea 11
  decapillata 11
  synsporos 11
Macowanites 54
Macrohilum 65
  eucalypti 65
Macrophoma 484
Macrosporium
  puttemansii 495

Massarina 458
  rubi 455, 457, 478, 484
Melanogaster
  berkelianus 238
  broomeianus 225
  owanianus 212, 242
Melanoporiella 400
  carbonacea 400
Melanotaenium 276, 295
  arthraxonis 276-277, 295
  brachiariae
    var. arthraxonis 276
    var. paspalidii 295, 301
Menegazzia 363-365, 369-370, 374, 376, 382-383, 386
 Subg. Dispora 377, 386
 Subg. Octospora 386
  albida 363-364, 388
  caliginosa 371, 373
  CHRYSOGASTER 363-364, 367-371*, 372-373, 377, 379, 382
  fumarprotocetrarica 363, 368-370, 374-375, 382
  globulifera 363, 365, 368-370, 375-376
  KAWESQARICA 363-364, 368-370, 373, 376*-381, 383, 387, 390
  magellanica 363, 368-370, 378-383, 386-387, 390
  neozelandica 363-364, 368-370, 379-380, 382-383, 385, 390
  norsorediata 363-364, 368-370, 373, 379, 384-386
  norstictica 386
  pulchra 386
  sanguinascens 363, 368-370, 373, 379, 386-387, 389
  subpertusa 376, 379
  tenuis 363-365, 368-370, 382, 388-389
  terebrata 382, 390
  wandae 368, 370, 382-383
Metatrichia
  floriformis 9
  vesparium 9
Microporellus 400
  dealbatus 400
  obovatus 400
Microsphaeropsis 59, 62
  callista 62
  concentrica 62
  DIFFISSA 59-60*, 62
  olivacea 62
  pseudaspera 62
Monilia
  aureo-fulva 151, 154
  ochracea 140
Monodictys 34
Montagnula 435-436
  yuccigena 436
Mycosphaerella 75, 88-90, 99, 327, 337, 464, 466-467, 478, 484
  bellula 89, 467
  HOLUALOANA 449, 458*-459, 464, 466-467, 478, 484
  jonkershoekensis 88-89, 467
  KONAE 449, 459*, 461-462, 466-467, 478
  leucadendrica 484
  LEUCOSPERMI 75, 87*-89, 99, 467
  SHOREAE 327, 334, 339*
  stromatosa 467
  WAIMEANA 449, 463*-464, 466-467, 478, 484
Mycovellosiella 337
Myxotrichum
  resinae 179

Naucoria
  rheophylla 38, 40, 257, 260, 262
Navisporus 400
  floccosa 400
Nectria
  pseudotrichia 99, 484
Neosartorya
  fischeri 417
Neovossia
  punensis 266, 290
  setariae 315
Nigrofomes 400
  melanoporus 400
Nigroporus 400
  vinosus 400

Odontia
  acerina 432
  setigera 432
Oidium 158
  album 129
  armeniacum 158
  aureo-fulvum 151, 154
  biforme 151-152
  chilense 130
  curtisii 137, 150
    var. ovalisporium 142
  elongatum 138
  gracile 137
  laevisporum 137
  morgani 158

[Oidium] ochraceum 140, 146
  pulchrum 158
  ramosissimum 146, 150
  rubiginosum 148, 152, 154
  simile 150-151, 154
  vesiculosum 157
Oligonema
  flavidum 9
  schweinitzii 9
Oligoporus 400
  balsameus 400
  caesius 400
  floriformis 400
  hibernicus 400
  leucomallellus 245, 250
  placentus 400
  tephroleucus 400
Oxyporus 400
  latemarginatus 400
  obduscens 400
  pellicula 400
  similis 400

Pachykytosora 400
  alabamae 400
  papyracea 400
Paecilomyces 116
  cicadae 123
  farinosus 123
Paradiacheopsis
  solitaria 11
Paradiplodia
  agropyri 64
Paraisaria 116
  dubia 118, 122
Parmelia
  omphalodes 425
  pertusa 390
Passalora 327, 330, 332, 336
  AMBROSIAE 331*
  FAGARINA 332*
  LETTSOMIAE 334*
  PANACIS 334, 336*
  QUERCI 337*, 340
Penicillium 99
Peniophora 248
  setigera 432
  subtestacea 432
Penzigomyces 34-35
Perenniporia 400
  aurantiaca 400
  chromatica 400
  contraria 400
  detritus 400
  inflexibilis 400
  isabellinus 400
  martius 400
  medullapanis 400
  ochroleuca 400
  parvispora 400
  roseoisabellina 400
  sprucei 400
  tenuis 401
  tepeitensis 401
  tephropora 401
  xantha 401
Perichaena
  chrysosperma 10
  corticalis 10
  depressa 10
  minor 10
  vermicularis 10
Periconia
  digitata 484
Pertusaria 407, 410
  lophocarpa 407-410
Pestalotiopsis 99, 449, 477, 485
Pestalozzia
  anthurii 495
  ardisiae 495
  puttemansii 495
Pezicula 161, 163-164
  acericola 164
  aesculea 164
  carpinea 164
  cinnamomea 164
  corni 164
  crataegicola 164
  eucalypti 164
  eucrita 164
  MAGNISPORA 161*-162, 164
  ocellata 164
  tasmanica 164
Phellinus 396
  apiahynus 396
  aureobrunneus 396
  badius 396
  calcitratus 396
  callimorphus 250, 396
  caryophylleus 396
  chryseus 396
  conchatus 403
  contiguus 396
  detonsus 396
  extensus 396
  fastuosus 396

[Phellinus] ferreus 396
  gilvus 396
  grenadensis 396
  igniarius 403
  johnsonianus 397
  maxonii 397
  melleoporus 397
  merrillii 397
  portoricensis 397
  punctatiformis 397
  punctatus 397
  rhytiphloeus 397
  robiniae 397
  roseocinereus 250, 397
  sanctigeorgii 397
  sarcites 397
  senex 397
  shaferi 397
  umbrinellus 397
  undatus 397
  undulatus 397
  wahlbergii 397
Pholiota 181
  Subg. Flammuloides 182
  Sect. Spumosae 182
  Stirps Scamba 182
    BAMBUSINA 181*-182, 184
    gregariiformis 184
    peleae 184
    pulchella 184
    scamba 184
Phoma 477, 485, 495-496
  macrostoma 495
Phomopsis 99
  guarea 496
Phyllachora 474
Phylloporia 397
  chrysita 397
  frutica 397
  pectinata 397
  spathulata 397
Phyllosticta 471
  anonae 495
  bauhinicola 495
  cydoniicola 495
  dioscoreae-daemonae 496
  guarea 496
  oroxylonis 496
  owaniana 471
  rubi 496
  sapindi 496
  telopeae 449, 467, 470-471, 477, 482
Phymatotrichopsis
  omnivora 99
Physalospora 474
  alpestris 474
  HAWAIIENSIS 449, 471*, 473-474, 478, 485
  hyalospora 474
  palmicola 474
  vitis-idaeae 474
Physarum 14
  bivalve 7
  cinereum 7
  citrinellum 7
  contextum 7
  compressum 7
  crateriforme 7
  decipiens 7
  flavicomum 7, 14
  flavidum 7
  globuliferum 7, 14
  lateritium 7
  leucopus 7
  listeri 7
  melleum 7
  murinum 7
  nucleatum 7
  nutans 7
  penetrale 7, 14
  polycephalum 12
  psittacinum 7
  pulcherrimum 7
  pusillum 12
  stellatum 9, 14
  sulphureum 9
  superbum 9
  tenerum 9
  vernum 12
  viride 9
Physisporinus 401
  sanguinolentus 401
Physospora
  elegans 148, 158
  rubiginosa 148, 150
  spiralis 134
Phytophthora 18, 20, 93, 99
  cinnamomi 477, 485
  cyperi 18
  cyperi-bulbosi 18
  fragariae 17-18, 20
    var. oryzo-bladis 17, 20
  lepironiae 18
  nicotianae 477
  ORYZO-BLADIS 17-18, 20*
  polygoni 18

Pithomyces 34
Placodiplodia 59, 63
  agropyri 64
  copelandii 64
  HILATA 59, 63*-65
  parinarii 64
  yuccae 64
Pleospora 79, 99, 267
  herbarum 99
Plicaria
  coronaria 229
  vesiculosa 229
Podohydnangium 54
Polyporoletus
  sublividus 250
Polyporus 401
  arcularius 401
  dictyopus 401
  gilvus 485
  grammocephalus 251, 401
  guianensis 401
  leprieurii 401
  phillipinensis 401
  squamosus 251
  tenuiculus 401
  tricholoma 401
  udus 245, 249, 251, 254
Porogramme 395
  albocincta 395
  lateritia 395
Protomerulius 401
  caryae 401
  substuppeus 245, 251
Prototrichia
  metallica 10, 13
Pseudodoassansia 274
  HYDROCLEYDIS 265, 274*-276, 279
  obscura 274
Pseudobeltrania 496
  cedrelae 496
Pseudocercospora 327, 329, 334, 339-340, 459, 461-462, 484
  bangalorensis 337
  broussonetiae 337
  exochordae 328
  fagaricola 334
  jamaicensis 338
  leguminum 338
  mysorensis 338
  panacis 336
  paramignyae 338
  petila 330
  PISTACIAE 334, 338*
  shoreae 339
  waltheriae 339
  wrightiae 339
  xanthoxyli 334
  ZANTHOXYLICOLA 327, 332, 334*
Pseudocyphellaria
  flavicans 386
Pseudofavolus 401
  cucullatus 401
  nigrus 401
  orinoccensis 401
Psilocybe 54
Puccinia 346
  AUSTROYUNNANICA 345*-346
  gouaniae 346
  gouaniae-tiliaefoliae 346
  gouaniicola 346
  incallida 346
  invaginata 346
  paraensis 346
Pycnoporus 401
  sanguineus 401
Pyrenochaeta 100
Pyrofomes 401
  fulvo-umbrina 401
  laeteritius 401
Pythium 18, 93, 100, 486

Ramularia 100
Repetophragma 34
Rhinotrichum
  armeniacum 158
  curtisii 134, 136-137
  globiferum 134
  laevisporum 137
  pulchrum 158
  ramosissimum 146
  rubiginosum 148, 150
  subferruginosum 134
  sumstinei 134
Rhizoctonia 486
  solani 100
Rhizopogon 191
  abietis 192
  aestivus 209, 213-214, 219, 227, 229-230, 234, 236, 238
  albidus 242
  albus 232
  angustisepta 192, 196, 209, 219, 229, 242
  aromaticus 192
  atroviolaceus 242
  aurantiacus 192
  borealis 217

[Rhizopogon] briardi 218, 228, 235
  briardii 202
  brunneicolor 242
  cokeri 243
  colossus
    var. coloccus 241
    var. nigromaculatus 241
  comatus 201
  corsicus 192
  couchii 243
  diabolicus 243
  duriusculus 234
  ellenae 193
  evadens 193
    var. evadens 193
    var. subalpinus 193
  fuscorubens 193
  galloprovincialis 242
  gigasporus 239
  globotus 213
  graveolens 201, 218, 227
    f. pomaceus 201, 213
    f. sulphurea 201
  hawkerae 240-241
  hawkeri 239
  hymenogastrosporus 238
  idahoensis 243
  induratus 200
  inodorus 216
  lapponicus 214, 217
  luteolus 191-193, 202-209, 211-220, 222, 224, 226-230, 232-239, 241-242
  luteorubescens 209, 218, 227, 229-230, 233-236
  lutescens 204, 225
  maculatus 241
  marchii 191, 201, 236
  melanogastroides 202
  minor 213
  mohelnensis 234
  nigrescens 243
  niveus 205, 220
  occidentalis 191, 202, 229, 236
  ochraceiosporus 243
  ochraceorubens 191, 204-205
  ochroleucoides 243
  olivaceofuscus 243
  oswaldii 243
  pachydermus 243
  pannosus 205
  parksii 240-241
  piceus 209
  pinicola 244
  provincialis 196, 201, 204-209, 212-214, 217-220, 224, 226, 228-230, 235-236, 242
    var. minima 210
  pseudoroseolus 217, 233
  quercicola 244
  reaii 244
  reticarpus 194
  reticulatus 240
  rhizophorus 194
  rocabrunae 205
  roseolus 191, 201, 203-206, 218, 225-226, 233, 238, 240, 242
    var. foetens 213, 227, 238
    var. intermedius 218, 234
    var. sulphureus 214, 227
    f. aberrans 239
    f. amygdalodora 211
  roseum 233
  rubescens 202-209, 211-230, 233-235, 238, 241-242
    var. ochraceus 226
    var. pallidimaculatus 226
    var. rubescens 227, 230, 234-236, 242
    var. sulphureus 233
    var. vittadini 209
    "rank?" beta amygdalodorus 212
  sardous 220
  semireticulatus 244
  separabilis 244
  suavis 230
  subalpinus 239
  subareolatus 240
  subcaerulescens 244
  subolivasens 239
  subsalmonius 239
  sulphureus 241
  tenuisporus 206, 216
    var. intermedius 216, 227
  truncatus 244
  ventricisporus 238-239
  verii 239
  villosulus 239
  vinicolor 241
  virens 196, 209, 212-213, 219-220, 226-227, 230, 242
  virescens 209, 233
  vittadinii 212
  vulgaris 194, 202-210, 212-214, 218, 220, 222-223, 225-227, 230, 236, 239
    var. intermedia 224-225
    var. intermedius 219-220, 226, 230
    var. vulgaris 203, 208, 211-212, 218
  webbi 211

Rhytidhysteron
  rufulum 100
Rigidoporus 401
  biokoensis 401
  crocatus 401
  lineatus 401
  microporus 401
  mutabilis 401
  ulmarius 401
  umbonatipes 401
  undatus 401
  vinctus 401
Russula 54

Saccharomyces
  cerevisiae 408, 410
Sarcostroma
  grevillieae 100
Schizopora 401
  cystidiata 401
  flavipora 401
  paradoxa 401
  radula 402
Scleroderma
  aurantium 235
Scolecostigmina 93
Scytalidium 356, 360
Secotium
  gunnii 48
  tenuipes 40, 257
Seimatoantlerium
  tepuiense 354
Seimatosporium 100
Septoria
  grandicipis 486
Seridium 100
  cardinale 100
Setchelliogaster 37-38, 45, 49, 52-55, 257
  aurantiacum 45
  australiensis 37, 39, 45, 49-55
  brunneus 45
  fragilis 45, 52
  rheophyllus 37-41, 45, 53, 55, 257-262
  tenuipes 37-40, 42-43, 46, 49, 51, 53-55, 257, 260-261
    var. RHEOPHYLLUS 257, 262*
    var. tenuipes 262
Seuratia
  globifera 486
Skeletocutis 402
  lenis 402
Sorosporium
  argentinum 279
  aristidae 266, 304, 307
  aristidae-amplissimae 302
  aristidae-cyananthae 303
  arthraxonis 266, 276-277
  bornmuelleri 307
  bullatum 305
  capillipedii 320
  confusum 266, 306
  consanguineum 307
    var. bullatum 266, 303, 305
  ellisii 306
  fraserianum 266, 308
  goniosporum 308
  maroccanum 266, 303, 311
  panici 266, 295
  penuriasorus 266, 303, 305
  tranzschelianum 277
Sphaceloma 86
  protearum 86, 481
Sphacelotheca
  aristidae-cyananthae 303
  aristidae-lanuginosae 266, 302, 304
  arthraxonis 266, 276-277
  chrysopogonicola 266, 320
  tricholaenae 280
    var. congoensis 281
Sphaeria
  sobolifera 116, 123
Sphlanchnomyces
  virens 217
Sporidesmium 34
Sporisorium 281, 302-304, 306, 311-313
  ARISTIDAE 266, 304*, 312
  ARISTIDAE-LANUGINOSAE 266, 304*, 312
  ARISTIDICOLA 266, 303, 305*-306, 312
  arthraxonis 266, 276-277
  COELORACHIDIS 265, 289-290, 292*
  CONFUSUM 266, 303, 306*-307, 312
  consanguineum 302-303, 306-308, 311-312
  desertorum 292
  FRASERIANUM 266, 303, 308*, 312
  GONIOSPORUM 266, 303, 307-308*, 312
  HORSFALLII 265, 297*-298, 301
  melinis 279, 281
  microsporum 266, 303, 311
  monachnes 280-281
  PANICI 266, 295*-296, 301
  POLYTOCAE 266, 286*, 290
  POLYTOCAE-BARBATAE 266, 286*
  POLYTOCAE-DIGITATAE 265, 284, 287*, 289-290
  reilianum 287, 290

[Sporisorium] rhynchelytri 280-281
  saharianum 302
  simile 288, 290
  tranzschelianum 266, 276-277
  tricholaenae 280-281
Sporopodium 23, 26-27
  AERUGINASCENS 23*-26
  antonianum 26
  aurantiacum 26-27
  citrinum 23-26
  flavescens 23-24, 26
  leprieurii 26
  lucidum 23-24, 26-27
  marginatum 26-27
  phyllocharis 26-27
  pilocarpoides 26-27
  xantholeucum 24-26
Sporotrichum
  rubiginosum 148, 150
Stanjehughesia 34-35
STEGOLERIUM 356*
  KUKENANI 353, 356*-360
Stemonitis
  axifera 11
  flavogenita 11
  fusca 11
  nigrescens 11
  pallida 11
  smithii 11
  splendens 11
  virginiensis 11
Stemonitopsis
  hyperopta 11
  typhina 11
Stemphylium 267, 486
Stenella 327, 340, 342-343, 463, 466, 484
  SALICIS 340, 342*
  SHOREAE 334, 339*
  SOLIDAGINIS 340, 342*
Stereum 248
Sterigmatocystis
  nigra 418
  sydowii 420
  versicolor 420
Stictis 475
  LEUCOSPERMI 449, 474*-475, 477-478, 486
  stellata 475
Stigmina 91, 93
  CALIFORNIAE 75, 91*-92, 100
Stiptophyllum 402
  erubescens 402
Suillus 54
Symphytocarpus
  herbaticus 11

Taeniolella 179
Teratosphaeria 94
Tetracrium 496
  aurantii 496
Thaxterogaster 54
Thelephora
  aspera 432
  setigera 432
Tilletia 266, 294, 303, 313, 318, 321
  ayresii 313-314
  chionachnes 288, 290
  CYNODONTIS 265, 290, 294*
  echinochloae 320
    f. foliicola 266, 320-321
  echinosperma 265, 313-314
  eleusines 313, 317
  heterospora 313
  hyparrheniae 314
  kimberleyensis 288, 290
  magnusiana 313
  makutensis 313, 315
  oklahomae 266, 309, 312
  PALPERA 265, 309*-310, 312
  pulcherrima 320-321
  PUNENSIS 266, 288, 290*
  setariae 313, 315-318
  setariae-palmifoliae 315-318
  setariae-palmiflorae 316
  SETARIAE-VIRIDIS 265, 316*, 318-319
  setaricola 317-318
  thirumalachari 317-318
  zundelii 318
Tinctoporellus 402
  epimiltinus 402
Tolyposporium
  aristidae 266, 304
Trabrooksia
  applanata 9
Trametes 402
  cingulata 402
  cubensis 402
  elegans 402
  ellipsospora 402
  hirsuta 402
  lactinea 402
  maxima 402
  membranacea 402
  modesta 402
  pavonia 402
  velutinus 403

[Trametes] versicolor 167-169, 171, 402
  villosa 402
Trapelia
  coarctata 409
Trapeliopsis 407, 409
  flexuosa 407-409
  granulosa 407-409
Trechispora 395
  brasilensis 395
  dimitica 395
  mollusca 395
  regularis 395
Trichaptum 402
  abietinus 402
  biforme 402
  byssogenum 402
  durus 402
  fumosavellanea 402
  perrottetii 402
  sector 402
  sprucei 402
Trichia
  botrytis 10, 14
  contorta 10
  decipiens 10
  erecta 10, 14
  favoginea 10
  floriformis 9
  persimilis 10
  scabra 10
  subfusca 10, 14
  varia 10
Trichoglossum 163
Trichophyton 418
Trichosporium
  tomentosum 154
Truncatella
  angustata 100
Tryblidiella
  rufula 100
Tuber
  borchii 202
  obtextum 201
Tubercularia
  laterina 484
Tubifera
  dimorphotheca 5
  ferruginosa 5
Tuburcinia
  aristidicola 305
  bomareae 268
  galanthi 268
  hypoxidis 268
  ixiolirii 269
  javanica 267
  leucoji 269
  narcissi 269
  sternbergiae 270
Tylopilus 105, 111
 Sect. Oxydabiles 113
 Sect. Potamogetones 105, 111-113
  arenarius 111
  beelii 111
  PAKARAIMENSIS 105-106*, 108, 110-113
  potamogeton 112
   var. aquarius 111-113
   var. irengensis 106, 111-113
   var. potamogeton 112-113
Tyromyces 245, 251, 253, 402
  aquosus 253
  atroalbus 254
  caesioflavus 254, 402
  chioneus 402
  fumidiceps 253
  hypocitrinus 253
  leucomallus 254, 402
  limitatus 254
  MEXICANUS 245, 249, 251*, 254
  neostrigosus 254
  nodulosus 254
  pelliculosus 252
  polyporoides 253
  preguttulatus 254
  pseudolacteus 245, 252, 255
  singeri 253
  subgiganteus 254
  SUBVIRIDE 245, 249, 252*, 254
  xuchilensis 255

Urocystis 267, 287
  ALSTROEMERIAE 265, 267*-268, 271-272, 279
  aristidicola 266, 305-306
  bomareae 268, 271
  colchici
   f. narcissi 269
  galanthi 268-269, 271
  hypoxidis 268, 270-271, 279
  ixiolirii 269, 271
  leucoji 269, 271
  narcissi 269, 271
  nevodovskyi 266-267, 270-271
  sternbergiae 270-271
  THAXTERI 265, 270*-271, 273, 279
Uromyces 349
  blandus 349

[Uromyces] HAINANICUS 349*-350
  kunigamiensis 349, 351
Ustilaginoidea 286, 302
Ustilago 281, 293, 311
  ACROCERATIS 265, 289-290, 293*
  aristidae 306-307
  aristidae-cyananthae 266, 303-304
  aristidarius 311-312
  aristidicola 266, 303, 311
  asprellae 266, 301-302
  arthraxonis 266, 276-277
  bornmuelleri 311
  bromivora 266, 298, 301-303, 311
  bullata 266, 295, 298, 301-302
  carbo
    "rank?" alpha vulgaris 302
    "rank?" d. bromivora 302
  chelandii 296
  chrysopogonis 266, 320
  delicata 280-281
  distichlidis 266, 321
  evansii 313
  goniospora 266, 308
  heterospora 313
  ixiolirii 267, 270
  LATZII 265, 282*-284
  microspora 311
  panici-geminati 266, 296
  panici-gracilis 296, 301
  paspalidicola 296
  polytocae 266, 286
  polytocae-barbatae 266, 286, 290
  rabenhorstiana 293
  rhynchelytri 279
  rickeri 266, 296, 301
  tricholaena
    var. congoensis 280
  tricholaenae 280
  trichophora 281
  TRIRAPHIDIS 265, 282*-284
  verruculosa 314
Ustilentyloma 266, 279, 320
  brefeldii 320
  fluitans 320
  OREOCHLOAE 266, 319*-320
  pleuropogonis 320

Vizella
  interrupta 94

Websteromyces 179
Weraroa 54
Willkommlangea
  reticulata 9
Wolfiporia 402
  cocos 402
Wrightoporia 402
  avellanea 402
  tropicalis 245, 255, 402

Zetiasplonza
  cordylines 100
Zygodesmus
  laevisporus 137
  serbicus 148
Zygosporium 486

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The Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume.

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Publication Date for Volume Seventy-Seven

MYCOTAXON for January-March 2001, volume 77: 1-540,
was issued on March 29, 2001.

MYCOTAXON is published quarterly during the periods of January–March, April–June, July–September, and October-December by Mycotaxon, Ltd., 316 Richard Pl., Ithaca, NY 14850–3129. Periodical postage paid at Ithaca, NY, and at additional mailing offices. Subscription rates: In U.S. and possessions, one year, $268.00; reduced rate for personal subscribers, one year, $128.00. Foreign subscriptions, add $8 for surface mail, or add $40 for ISAL air mail.

POSTMASTER: Send address changes to Mycotaxon, Ltd., P.O. Box 264, Ithaca, NY 14851-0264.

MYCOTAXON

Volume LXXVIII, pp. 539-540 April-June 2001

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